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OF THE

California Academy of Sciences

FOURTH SERIES

Vol XXV

ALICE EASTWOOD
SEMI-CENTENNIAL PUBLICATIONS

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1943–19~~44~~

Alice Eastwood

TO

ALICE EASTWOOD

IN COMMEMORATION OF FIFTY YEARS OF SERVICE AS
CURATOR OF THE DEPARTMENT OF BOTANY OF THE
CALIFORNIA ACADEMY OF SCIENCES
1892-1942

THIS VOLUME IS DEDICATED IN RESPECT AND AFFECTION

FOREWORD

THIS VOLUME of the Proceedings of the California Academy of Sciences honoring Miss Alice Eastwood was initiated in 1942, on the occasion of her completion of fifty years of service as Curator of the Academy's Department of Botany. Owing to wartime problems of publication, the first number of the projected volume was not issued until December, 1943. The volume has been continued through the succeeding years and is now concluded with this number which, happily, we are able to issue on the occasion of Miss Eastwood's ninetieth birthday, and in recognition of her fifty-seven years of service to the Academy.

On her ninetieth birthday Miss Eastwood will, at her own request, retire from her post as Curator of Botany. The Academy's Council is proud to grant her the title of Curator Emeritus—a title which, however, seems singularly inappropriate to a gallant lady who will be forever young.

The biography of Miss Eastwood that is here presented was prepared by Dr. F. M. MacFarland, President of the Academy from 1932 to 1946, in collaboration with Dr. R. C. Miller, Director of the Academy, and Mr. John Thomas Howell, Assistant Curator of Botany. The bibliography of Miss Eastwood's writings was prepared by Dr. MacFarland and Miss Veronica J. Sexton, the Academy's Executive Librarian. The thankless task of indexing the volume was performed by Dr. MacFarland alone.

For all those who participated in its preparation and publication, this volume represents a labor of love.

M. E. LOMBARDI,
President of the Academy

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BIOGRAPHICAL SKETCH OF ALICE EASTWOOD

On January 19, 1859, in two localities, some two thousand miles apart, there were in progress two separate and apparently unrelated series of events that were destined to become, at a later date, of considerable mutual importance In San Francisco, the California Academy of Sciences, an organization then less than six years old, was struggling successfully through the precarious early years of its existence In Toronto, Canada, Alice Eastwood was born

More than thirty years were to elapse before the events referred to became significant for each other Nevertheless, even before Alice Eastwood was born, the avenue that was to lead her to distinguished botanical career had been opened by the "scientific gentlemen" (as they described themselves in their first constitution) who made up the California Academy of Sciences As if with prophetic insight, Dr Albert Kellogg, one of the founders of the Academy and its most prominent early botanist, had proposed in a quaintly worded resolution that was adopted at the meeting of August 1, 1853 "Be it resolved, as the sense of this society, that we highly approve of the aid of females in every department of natural history, and that we earnestly invite their cooperation " Thus, through Dr Kellogg's resolution, as gallant in intent as it was inept in phrase, the California Academy of Sciences became very probably the first institution in the world to formally encourage the participation of women in scientific work, as it became later the first to admit women to senior curatorial positions

While Alice Eastwood was still a young girl, her family moved from Toronto to Denver, Colorado where she obtained her high school education, graduating from the East Denver High School with its first class in 1879 Her marked ability and eager thirst for knowledge led her to be drafted as a substitute teacher before she had finished high school, and she continued as a regular teacher for the next ten years Despite the burden of teaching a great variety of more or less unrelated subjects, her innate love of Nature asserted itself and the plants, shrubs, and trees of Colorado appealed to her with irresistible charm At every opportunity she explored the plains, valleys, and mountains, the rugged canyons, streams, and rivers of the state, and brought together a tangible record of her field studies in the Eastwood Herbarium, which later was to become the pride of the Denver Museum Without access to a scientific library or contacts with other biologists, she became, herself, a self-taught botanist Gray's Manual, covering the flora of the eastern states was her earliest guide to unraveling the family and in part the generic relationships of the Colorado plants, and she welcomed with delight the appearance of Coulter's Manual of Rocky Mountain Botany in 1885, and she soon found ample work to do in extending its application to the rich Colorado flora

In 1890, Miss Eastwood made a vacation trip to southern California, studying especially the plants of the San Diego region Returning in the next year, she spent some months as an assistant in the herbarium of the California Academy of Sciences As a result, she was induced to leave her Denver position in 1892, and to cast her lot with the Academy, soon becoming joint Curator of Botany with Mrs Katherine Brandegee Three years later, upon the retirement of Mrs Brandegee, she became Curator and Head of the Department of Botany which position she has filled until the present

In the forty-seven years of its existence, the California Academy of Sciences had grown from its simple beginnings to be the leading center of research in the Natural Sciences of the Pacific Coast Its herbarium, built up by the pioneers, Albert Kellogg, H N Bolander, Harry M Harkness, and E L Green, and continued by T S and Katherine Brandegee and others, had become one of the largest in the West, and was in constant use by student workers Miss Eastwood at once entered upon work to increase its value Aside from her routine curatorial duties, she collected and studied plants and trees near and far The Bay region was thoroughly explored and trips were made to Mt Shasta, to Del Norte County, to the Santa Lucia Mountains, and the interior valleys, returning with much new material for the herbarium

In those pre-automobile days, travel away from the railroads was often difficult By stage, on horseback, or afoot, Miss Eastwood made her way over mountain roads and trails with unflagging zeal

As a result of her activity and that of those whom she inspired, the herbarium steadily increased in size and scientific value The great earthquake and fire of 1906, however, destroyed much of San Francisco in a few hours, and the museum and collections of the Academy shared the same fate Through Miss Eastwood's initiative and courage, though, some important things were saved—the records of the Academy from its beginning, and twelve hundred and eleven invaluable botanical types, irreplaceable if lost Miss Eastwood had long recognized their value and had segregated them from the thousands of other specimens, so that when the emergency came, she was able to find them without delay in the wrecked building and to transport them to a place of apparent safety—a refuge that nevertheless had to be changed twice before the approaching flames In doing this, she unhesitatingly abandoned her own personal possessions, her favorite pocket lens alone being saved In a letter to SCIENCE for May 25, 1906, describing the destruction of the Academy and collections, she wrote "I do not feel the loss to be mine, but it is a great loss to the scientific world and an irreparable loss to California My own destroyed work I do not lament, for it was a joy to me while I did it, and I still can have the same joy in starting it again To me came the chance to care for what was saved from the ruins of the Academy, and with the help of my devoted friends I was able to do it"

The type specimens saved through Miss Eastwood's courage formed the nucleus of the new collections But owing to the total destruction of its property and the interruption of its income, it was several years before normal activity could be resumed During this time, Miss Eastwood studied in the

ALICE EASTWOOD

About 1880, at the beginning of her botanical career

great herbaria of the Smithsonian Institution at Washington, the New York Botanical Garden, and Harvard University, and also spent a number of months in the Kew Gardens, the British Museum, the University of Cambridge, and the Jardin des Plantes

With the new site for its buildings in Golden Gate Park assured and construction begun, the Academy's normal scientific activity was resumed Miss Eastwood returned in June 1912, and at once vigorously began the replacement of the herbarium of the Department of Botany and the rebuilding of its library, collecting trips were made at every opportunity Through the cooperation of Professor Charles S Sargent of the Arnold Arboretum, she made a trip to Alaska in 1914, collecting and studying especially the willows of the Yukon region for his *Sylva of North America* Later, studies were also made by her in southern California, Arizona, and New Mexico for Professor Sargent She made other extensive trips to all parts of California, to Oregon, Nevada, Utah, Arizona, New Mexico, and Lower California, returning with abundant material for the rapidly growing herbarium Additional collections made by others came from Mexico, Central America, South America, and the Pacific Islands

Especial attention has also been given to securing specimens of the exotic plants which have been introduced into California gardens and parks, a field often neglected in herbaria, but of great importance for comparative study

Miss Eastwood's publications as shown in the accompanying bibliography of over three hundred titles have been many and varied. The majority of them are, of course, technical botanical studies, but others are of more general interest inculcating an appreciation of the out-of-doors and the conservation of its treasures In addition, the admirably edited "Leaflets of Western Botany" published by her and Mr J T Howell, Assistant Curator of Botany, affords a prompt means of publication for shorter articles by western botanists

It is worthy of particular remark that, while Miss Eastwood had written more than one hundred papers by the time she was fifty years of age, and was considered sufficiently distinguished to be starred in the first edition of *American Men of Science* (1906), two-thirds of her published writings have been issued since that time, and fifty-five of them since her eightieth birthday

Miss Eastwood has taken a prominent part in promoting the welfare of many scientific organizations interested in plant life She has been the active head of the California Botanical Club (of San Francisco) since its second year in 1892 She has participated in the work of the California Floral Society, the San Francisco Garden Club, the California Spring Blossom and Wild Flower Association, the American Fuchsia Society, the California Horticultural Society, and is a member of the Science Club, the Alpine Club, the Tamalpais Conservation Club, and other organizations devoted to the out-of-doors and its conservation She became a Member of the California Academy of Sciences in 1892, a Life Member in 1917, was elected a Fellow of the Academy on February 25, 1928, was declared a Patron on December 31, 1930, and was unanimously elected an Honorary Member of the Academy at its Annual Meeting on February 18, 1942

She has represented the Academy in many scientific meetings at home and abroad Among these latter are the International Congress held in Cambridge in 1930, in Holland in 1935, and the Centennial Anniversary of the Jardin des Plantes in the same year

Notwithstanding the pressure of her scientific activities, Miss Eastwood has never been too busy to help others, to answer the countless questions that come to her daily, to extend willingly to others the richness of her knowledge Her frank, direct approach to every problem and her modest, kindly spirit have won for her the esteem and love of countless loyal and devoted friends who wish for her many more years of productive activity in the field she loves

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Gentiana tenella in California Leaflets of Western Botany, I 16. (April)
Another station for *Zygophyllum Fabago* L Leaflets of Western Botany, I 16 (April)
Verbena bonariensis L Leaflets of Western Botany, I 21 (Sept)
Cypripedium fasciculatum in California Leaflets of Western Botany, I 22 (Sept)
Bottle brushes in Californian gardens and parks Leaflets of Western Botany, I 9–11, April 4, 1932, I 17–19, Sept 21, 1932, I 25–26, Nov 18, 1932, I 33–34, Jan 19, 1933, I 45–48, Mar 20, 1933
The fetid adder's tongue Leaflets of Western Botany, I 24 (Sept)
Concerning *Pittosporum daphniphylloides* Leaflets of Western Botany, I 24 (Sept)
The tree ferns in Golden Gate Park Bay Cities Garden Monthly, 1 2 2 figs (Nov)

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Taxus brevifolia in Marin County, California Leaflets of Western Botany, I 38–39 (Jan)
A new yerba santa Leaflets of Western Botany, I 40–41 (Jan)
An undescribed lily from the Sierra Nevada of California Leaflets of Western Botany, I 41–43 (Jan)
Ledum as a poisonous plant Leaflets of Western Botany, I 43 (Jan)
A new *Mimulus* Leaflets of Western Botany, I 44 (Jan)
Flowers along the highways Bay Cities Garden Monthly, 2 2, 8 (Feb /Mar)
Two new species of western *Galium* Leaflets of Western Botany, I 55–56 (Mar)
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Juniperus chinensis variety *Torulosa*, an undescribed variety of Chinese juniper Bay Cities Garden Monthly, 2 2, 7 1 fig (April)
Bottle brushes recently introduced into California Leaflets of Western Botany, I 57 (Aug)
New manzanitas from Santa Cruz Island, California Leaflets of Western Botany, I 61–63 (Aug)
Manzanitas California Out of Doors (Sept)
Madrone and manzanita. Trails, 10 2 (Oct)
Escallonias in Golden Gate Park Leaflets of Western Botany, I 65–69 (Nov)
New species of California *Arctostaphylos* Leaflets of Western Botany, I 73–80 (Nov)

1934 *Cheiranthus grandiflorus*, a correction Leaflets of Western Botany, I 87–89 (Jan)
A key to the common families of flowering plants in California, and A guide for the analysis and description of flowering plants Prepared for and published by the California Botanical Club, California Academy of Sciences San Francisco, The James H Barry Company, 1934 16 pp
Escallonias in Golden Gate Park—II Leaflets of Western Botany, I 81–82 (Jan)
Gentiana Copelandi Eastwood Leaflets of Western Botany, I 96 (Jan)
A revision of the genera formerly included in *Arctostaphylos* Leaflets of Western Botany, I.97–100 (May)
A new species of *Solanum* Leaflets of Western Botany, I 104 (May)
A revision of *Arctostaphylos* with key and descriptions Leaflets of Western Botany, I 105–127 (Aug)
Gladiolus segetum Ker Gawl in Sonoma County, California Leaflets of Western Botany, I 131 (Nov)
New species of Liliaceae Leaflets of Western Botany, I 132–133 (Nov)
A new species of *Talinum* from British Columbia Leaflets of Western Botany, I 139 (Nov)
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New species of Californian *Castilleja* Leaflets of Western Botany, I 174–176 (Mar)

A new loco weed from Oregon Leaflets of Western Botany, I 178–179 (May)

1936 New boreal species of *Castilleja* Leaflets of Western Botany, I 193–195 (Feb)

Castilleja multisecta Eastwood Leaflets of Western Botany, I 195 (Feb)

Adenoplea madagascariensis Leaflets of Western Botany, I 197 (Feb)

A new *Townsendia* from Utah Leaflets of Western Botany, I 206–207 (Feb)

The most minute *Mimulus* Leaflets of Western Botany, I 207 (Feb)

The shrubby malvastrums of California with descriptions of new species and a key to the known species Leaflets of Western Botany, I 213–220 (April)

Osmanthus aurantiacus (Makino) Nakai Leaflets of Western Botany, I 224 (April)

A new *Ribes* from the Sierra Nevada Leaflets of Western Botany, I 230–231 (Aug)

Malvastrum fragrans Eastwood Leaflets of Western Botany, I 232 (Aug)

Variations in *Castilleja* Leaflets of Western Botany, I 235–238 (Nov)

1937 New species of western plants Leaflets of Western Botany, II 7–9 (Jan)

Quest for lilies Leaflets of Western Botany, II 27–29 (April)

Nolina Parryi in Ventura County, California Leaflets of Western Botany, II 29 (April)

New species of *Dodecatheon* Leaflets of Western Botany, II 36–38 (Aug)

New localities in North America for *Sphaerophysa Salsula* (Pall) DC Leaflets of Western Botany, II 38 (Aug)

Zygadenus fontanus, a new species from Mt Tamalpais Leaflets of Western Botany, II 41–42 (Aug)

A brief history of the fuchsia Journal of San Mateo Garden Club (Sept /Oct)

Notes on *Schizococcus*, with a key to the species Leaflets of Western Botany, II 49–50 (Nov)

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The cestrums cultivated in California Golden Gardens, 6 8 (Feb)

The perennial lupines of California, I Leaflets of Western Botany, II 81–86 (April)

The tobacco collected by Archibald Menzies on the northwest coast of America Leaflets of Western Botany, II 92–94, pl II, figs 1–2 (April)

Allium lacunosum Wats var *micranthum* Eastwood. [Footnote to "A Botanical visit to the Vancouver Pinnacles, by John Thomas Howell "] Leaflets of Western Botany, II 101 (April)

Jamesia americana var *californica* (Small) Jepson Leaflets of Western Botany, II 102 (April)

Two new Scrophulariaceae Leaflets of Western Botany, II 104 (April)

New species of Liliaceae Leaflets of Western Botany, II 109–112 (July)

The yellow flowered perennial lupines of the Pacific States Leaflets of Western Botany, II 125–128. (Nov)

A new variety of *Delphinium californicum* Leaflets of Western Botany, II 137–138 (Nov)

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New California plants Leaflets of Western Botany, II 186–188 (April)
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The *Lupinus Breweri* aggregate Leaflets of Western Botany, II 249–253 (April)
New western plants Leaflets of Western Botany, II 263–269 (July)
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On the golden anniversary of the California Botanical Club Leaflets of Western Botany, III 26–27 (April)
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Some veronicas in Golden Gate Park Leaflets of Western Botany, III 220–222 (April)

Some alpine castillejas of the high Sierra of California Amer Midland Naturalist, 30 40–46, 1 pl (July)

Variations in *Castilleja plagiotoma* Leaflets of Western Botany, III 248–249 (July)

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New varieties of two well known California plants Leaflets of Western Botany, IV 166–167 (May)

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The lure of Arizona rock ferns American Fern Journal, 36 49–51 (Apr /June)

A tentative key to the small flowered lupines of the western United States Leaflets of Western Botany, IV 217–222, 1 pl (Jan.), 251–254 (May)

The prostrate oaks of Marin County, California Leaflets of Western Botany, IV 241–242 (May)

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Notes on Arctostaphylos *Uva-ursi* Leaflets of Western Botany, IV 268–269 (Aug)

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ALICE EASTWOOD SEMI-CENTENNIAL PUBLICATIONS

No. 1

A REVISION OF THE GENUS FUCHSIA (ONAGRACEAE)

BY

PHILIP A MUNZ
Professor of Botany, Pomona College

INTRODUCTION

FOR A LONG TIME a garden favorite, the genus *Fuchsia* seems in recent years to have stimulated new interest and enthusiasm, and many new importations of botanical species have been propagated and are being used for hybridization and culture The great variation in habit, in size, in color, in climatic conditions to which native,—all add to the possibility for use both as an indoor plant, and for milder climates, as a garden plant which can be adapted to hanging baskets, ground cover, shrub, vine or tree With flowers ranging in size from a few millimeters to many centimeters, through various shades of green, red to purple, it is not surprising that it should command attention Strangely enough, so important a genus has had no botanical revision since many of the species have become known For horticultural as well as for botanical purposes, it seems desirable to know what the species are and where they come from To this end, the present paper is presented

Fuchsia was first made known to science by a monk named Father Charles Plumier who described a species which he called "*Fuchsia triphylla flore coccineo*" in his "Nova Plantarum americanarum Genera," p 14, tab 14, 1703 Linnaeus in 1753 based his *Fuchsia triphylla* on Plumier's description and figure For a long time there was confusion as to the application of this name, it being used commonly for species from Colombia, such as *F venusta*, but now it seems pretty well demonstrated that Plumier's plant came from Santo Domingo *Fuchsia* was apparently first introduced into England about the end primitive. The range of *Quelusia*, with *F magellanica* in southern Argentina and Chile and with the other species occurring in the mountains of southeastern Brazil, is an interesting one, and entirely different from all the rest of the genus The Brazilian species have the sepals more or less connate at the base

The section *Eufuchsia* is the most inclusive one in the genus To me its most primitive species is *F splendens* of Mexico, which seems near to *Quelusia* in its long exserted stamens, but has too long a hypanthium which is also peculiar in being very wide at the base This species resembles more closely the section *Eufuchsia* than *Quelusia* in its large leaves From it there can be arranged two series of species one with long hypanthium, the second with shorter one Both series run from solitary axillary flowers to well defined inflorescence In the first series I would place nearest to *F splendens* the Guatemalan *F cordifolia,* in which the hypanthium has a broad base and the leaves are wide, but the hypanthium is longer and the stamens less exserted From this through *F austromontana* of Peru there can be derived a group with subcylindric hypanthium rather wide at the base, but with narrow petals *F denticulata, F leptopoda, F Woytkowskii,* and *F magdalenae* Another group with wider petals and somewhat less broad hypanthium-base, but continuing the subcylindric condition contains *F canescens, F rivularis, F loxensis, F. pallescens, F Townsendii, F platypetala,* and *F macrostigma* Then comes a series with more ampliate hypanthium and wide petals. *F. ayavacensis, F. Pringsheimii,* and *F triphylla,* these have axillary flowers With narrower petals and ampliate hypanthium and with flowers axillary or subterminal we have *F petiolaris, F Smithii, F. Llewelynii, F Asplundii, F venusta, F Jahnii, F Gehrigeri, F simplicicaulis,* and *F confertifolia* With the hypanthium narrow and long, and with the flowers in a short, terminal, definite inflorescence and with leaves large, are *F Aspiazui, F. tincta, F Mathewsii, F Fischeri, F Storkii, F furfuracea, F Munzii, F hirtella, F polyantha, F corymbiflora, F abrupta, F. Cuatrecasasii, F Killipii, F. boliviana,* and possibly *F fulgens*

The other great series which I would derive from the *cordifolia* type has a short hypanthium Here again one can begin with axillary flowers with rather wide hypanthium-base, such as in *F. decussata* and *F hypoleuca,* and then go to species with a narrower base, such as *F scabriuscula* and *F verrucosa* and *F sanctae-rosae,* this last named having either axillary flowers or almost terminal inflorescence From it one passes very easily into a large group with definitely terminal inflorescence· *F Osgoodii, F Andrei, F. Lehmannii, F putumayensis, F Hartwegii, F ovalis, F asperifolia, F pilosa, F glaberrima, F macrophylla, F. sessilifolia,* and *F sylvatica.* These species of *Eufuchsia* are almost entirely Andean, excepting *F splendens, F cordifolia,* and *F. fulgens* of Mexico and Central America, and *F. triphylla* and *F Pringsheimii* of the West Indies

The section *Kierschlegeria* of Chile with its single species *F lycioides* is an interesting xerophyte which must be related to *F magellanica* in its short hypanthium and small flowers I should suppose too that the section *Skinnera* of New Zealand and Tahiti with small flowers and reflexed sepals is of similar relationship, that is to the Patagonian *magellanica* In its reduced or even obsolete petals it becomes a very distinct group that must have been long isolated.

The same tendency to reduction or suppression of petals is seen in a long-tubed Andean series undoubtedly related to *Eufuchsia* rather than to *Quelusia* and for which I propose the section *Hemsleyella* The species I have included here are doubtless not all of the same origin In fact, I doubt that *F cestroides* should be included with the others They, in turn, are partly of the type with cylindrical hypanthium, for example, *F macrantha* and *F Garleppiana,* or with ampliate hypanthium as in *F apetala* In addition to the suppression of petals, specialization is evidenced by such features as union of sepals at their base, loss of leaves at anthesis, etc

Perhaps the most highly specialized section is *Encliandra* which occurs from Panamá to central Mexico. Small-flowered, with small leaves, and the shorter series of stamens bent back into the hypanthium, this group also tends in varying degrees to polygamy It has also relatively few seeds in the berry It may be perhaps related to the section *Schufia* (with erect flowers in large compound inflorescence) of the same geographical area in its small flowers and relatively short hypanthium Just how these two groups are related to the rest of the genus is not clear, perhaps the short hypanthium ties them in with the apparently rather primitive *Quelusia* which must have come from common stock with them

THE GENUS **Fuchsia** Linnaeus

Fuchsia L , Gen Pl , ed. 1, 27, 1737 , ed. 5, 126, 1754; Sp Pl , ed 1, 1191, 1753 ENDLICHER, Genera Pl , 1193, 1840 BENTH and HOOK , Gen Pl., 1, part 3 790, 1862 RAIMANN in Engler and Prantl, Die nat Pflanzenfam , III, 7 219, 1898

Hypanthium prolonged beyond the ovary, usually colored, deciduous in fruit Sepals 4, usually colored, deciduous Petals 4, or minute, or 0, convolute or spreading, deciduous Stamens 8, usually unequal, the episepalous exceeding the epipetalous , filaments more or less filiform ; anthers linear to oblong Pollen grains single, 2- or 3-angled Ovary 4-loculed , style elongate , stigma capitate or clavate, subentire to 4-lobed Suffrutescent to arboreous Leaves opposite to alternate or whorled, with small usually deciduous stipules Flowers solitary in the axils or racemose or paniculate, mostly pendulous and long-pedicelled, generally showy ; perfect to polygamous

Type species, *F triphylla* L.

KEY TO SECTIONS OF FUCHSIA

A Petals lacking or reduced to small scalelike structures , leaves tending to be alternate
B *Hypanthium infundibuliform,* not more than 1 5 cm. long , *sepals reflexed,* separate
New Zealand and Tahiti 4 *Skinnera*

BB Hypanthium tubular to funnelform, mostly more than 2 cm long; sepals divergent to suberect, more or less connate at base. South America 5. *Hemsleyella.*

AA. Petals present, almost or quite as long as sepals, leaves mostly opposite or whorled

B Leaves with a thickened persistent petiole-like base which becomes spine like, sepals reflexed, flowers small Chile . 3 *Kierschlegeria.*

BB Leaf bases not persisting as spine like structures.

C Flowers erect in terminal cymose panicles arranged subtrichotomously Mexico to Panamá . 6 *Schufia*

CC Flowers mostly pendulous, not in cymes.

D Flowers tending toward polygamy, small, inconspicuous, stamens short, the epipetalous reflexed; berry few seeded Mexico to Panamá 7 *Encliandra*

DD Flowers perfect, usually showy, stamens more or less exserted, erect, berry many seeded Mostly South American species.

E Hypanthium usually not longer than the sepals, stamens long exserted Eastern Brazil to Patagonia . 1 *Quelusia*

EE Hypanthium several times as long as sepals, stamens not much exceeding sepals Andes north of central Argentina to Mexico and West Indies 2 *Eufuchsia*

Section 1 QUELUSIA (Vand) DC

Quelusia as genus, Vandeli, Fl Lusit, 23, pl 10, 1788, and in Roem, Script Hisp Lusit, 101, 1796

Nahusia Schneev, Ic, 27, 1793

Thiloum Molina, Sagg Chile, ed 2, 146, 1810

Quelusia as sect, DeCandolle, Prodr, 3 36, 1826.

Nectary fused to base of hypanthium, hypanthium cylindric, usually no longer than sepals, stamens long, exserted

Type species Vandeli described the genus without naming a species De Candolle has *F coccinea* under Quelusia, as well as other species, he included *F magellanica* as a synonym of *F coccinea* Since Vandeli referred to petioled leaves, he evidently had in mind *F magellanica* Lam, and I would make it the type species

Key to Species of Section QUELUSIA

A Hypanthium short, 3–6 mm long, younger branches pubescent to pilose

B Leaf blades 4–10 cm long, 2–4 cm wide, quite entire 6 *F regia* var *alpestris*

BB Leaf blades 1 5–5 cm long, 0 3–2 (2 5) cm wide, mostly serrulate

C Young growth strigulose, leaves mostly less than 6 mm wide, coriaceous Itatiaya, Brazil 1 *F Campos Portoi*

CC Young growth puberulent to pilose, leaves mostly more than 6 mm wide, membranous.

D Suffrutescent, with herbaceous stems 2–5 dm tall; pedicels 1–2 cm long, stems very densely shaggy pilose Espiritu Santo, Brazil 2 *F. Bracelinae*

DD Well developed shrub, 1–3 m tall; pedicels 2–4 cm long, stems puberulent to somewhat pilose Minas Geraes, Brazil . 4 *F coccinea.*

AA Hypanthium longer, mostly 8–20 mm. long, younger branches usually glabrous or nearly so

B Leaf blades subentire, 4–10 cm. long, 2–4 cm wide, sepals connate at base for 2–15 mm So. Brazil . . . 6. *F regia*

BB Leaf blades serrulate, 1–5 cm long, sepals mostly free.

C Petioles mostly 3–10 mm long; hypanthium 8–10 (12) mm long, sepals 15–25 mm long, 3–4 mm wide So Chile and So Argentina . 3. *F. magellanica*

CC Petioles mostly 10–25 mm long, hypanthium 10–20 (or more) mm long, sepals 25–30 mm. long, 8–11 mm wide Gardens, naturalized as in Colombia, Venezuela . . 5 *F hybrida.*

(1) **Fuchsia Campos-Portoi** Pilger and Schulze

(Plate 1, fig 1)

Fuchsia Campos Portoi Pilger and Schulze, Notizblatt, 12:470, 1935

Shrub, with woody ascending or divaricate branches, the younger ones very slender, strigulose, more or less reddish, leaves opposite or ternate or quaternate, elliptic-lanceolate, acute at both ends, plainly serrulate with incurved, gland-tipped teeth, coriaceous, strongly bicolored, glabrous above or strigulose on midrib, strigulose beneath especially on midrib and margins, lateral veins inconspicuous, about 5 on each side of midrib, blades 1 5–2 5 (3) cm long, 3–5 (8) mm wide, petioles 2–3 (4) mm long, puberulent, stipules subulate, 0 5 mm long, deciduous, flowers solitary in upper axils, pedicels filiform, strigulose, 4–15 mm long, ovary 4–5 mm long, hypanthium red, broadly fusiform, 4–5 mm long, sparsely strigulose without, glabrous within, sepals red, somewhat strigulose, oblong-lanceolate, acuminate, 18–20 mm long, 4–6 mm wide, connate for 2–3 5 mm at base, petals violet, obovate-cuneate, slightly emarginate, 10–12 mm long, episepalous stamens 20–25 mm long, alternate ones slightly shorter, anthers 1 5 mm long, style glabrous, ca 3 cm long, stigma subentire, ca 2 mm. long, fruit ellipsoid, ca 1 cm long

From Itatiaya, Serra da Mantiqueira, state of Rio de Janeiro, Brazil, where it grows at 2100–2300 m alt Material seen, *Pilger and Brade 31,* type coll Dec 27, 1934 (POM, R), *Brade 15676,* March, 1934 (POM, R), *Loefgren 5775,* March 13, 1903 (POM, SP) I am greatly indebted to Dr Brade of the Botanical Garden at Rio de Janeiro for information concerning and material of this species The species is characterized by its narrow leaves, woody habit, strigulose younger growth, and fascicled appearance of the short branches

(2) **Fuchsia Bracelinae** Munz, new species

(Plate 1, fig 2)

Suffrutescent, with running underground rootstock and erect, rather simple stems 2–5 dm tall, woody and with exfoliating epidermis at base; stems herbaceous, apparently reddish and densely pilose with light-colored hairs up to 1 mm long; leaves opposite, in 3's or 4's, ovate-lanceolate, green and somewhat strigose above, paler, reddish and pilose beneath especially on veins, rounded at base, acute-acuminate at apex, subentire to denticulate, membranaceous, distinctly veined (main laterals 6–8 on each side of midrib); blades 2–5 cm long, 5–14 mm. wide, petioles 1–3 mm. long, villous, stipules lance-deltoid, 0 5–1 5 mm long, deciduous, flowers axillary, pedicels pilose, filiform, 1–2 cm. long, ovary oblong, pilose, 5 mm. long, hypanthium dark red, pilose without, glabrous within, 3 5–5 mm. long, 2–2.5 mm wide at slightly expanded summit; sepals rose, 19–23 mm long, sparsely pilose, connate at base for 3–4 mm., then erect-divergent, lance-oblong or -elliptic, subacuminate, 5–6 mm. wide, 3-veined, petals purple, obovate, 11–15 mm. long, rounded apically, episepalous stamens up to 3 cm long, epipetalous ca. 3 mm shorter; filaments reddish, anthers less than 2 mm long, reddish, style reddish, up to 3 5 cm long, glabrous, stigma slightly lobed, narrow, 1 5 mm long, immature fruit oblong, 8 mm long, 4 mm. wide

Suffrutescens, caulibus erectis, 2–5 dm altis, herbaceis, pilosis, foliis oppositis, ternatis aut quaternatis, ovato lanceolatis, in superficie superiore strigosis, inferiore pilosis, base rotundatis, apice acuto-acuminatis, subintegris vel denticulatis; laminis 2–5 cm longis, 0 5–1 4 cm latis, petiolis villosis, 1–3 mm longis, pedicellis axillaribus, pilosis, filiformibus, 1–2 cm. longis, ovario oblongo, piloso, 5 mm longo, hypanthio 3.5–5 mm longo, supra 2–2 5 mm lato, externe piloso, interne glabro; sepalis roseis, 19–23 mm longis, sparse pilosis, lanceolato oblongis aut ellipticis, subacuminatis, 5–6 mm latis, petalis purpureis, obovatis, 11–15 mm longis, staminibus 2 5–3 cm. longis, rubris, stylo glabro, 3–3.5 cm longo, bacca oblonga, 8 mm longa, 4 mm lata

Type from rocky, open campo, Serra de Caparáo, State of Espiritu Santo, Brazil, Nov 25, 1929, at 2650 m., *Ynez Mexia 4013*, Gray Herb, isotypes (CAS, NY, US); distributed as *F. pubescens* Distinct from *F Campos-Portoi* and *F. coccinea* in its more herbaceous habit, from the former by its broader thinner leaves and more hair, from the latter by its narrower leaves It is a pleasure to dedicate this species to Mrs H P Bracelin of Berkeley, California, who has devoted much time and energy to distributing the large collections made in Latin America by Mrs Mexia

(3) **Fuchsia magellanica** Lam

Fuchsia magellanica Lam, Encycl, 2 565, 1788 ! (cf. Kuntze, Rev Gen Pl., 1 cxxxii, 1891), pl 282, fig 2, 1793.

Shrub up to 2 5 m. tall, bushy or semiscandent, freely branched, the ultimate branchlets very slender (ca 1 mm thick), usually reddish, glabrous to finely and sparsely puberulent, especially about the nodes, older ones exfoliating, leaves opposite or ternate, sometimes alternate, usually rather crowded, the blades lance-ovate to rhombic-ovate to elliptic-ovate, rounded or more frequently somewhat cuneate at the base, acute to acuminate at the apex, usually evidently serrulate, more or less reddish on veins, paler beneath than above, glabrous to puberulent on margins and veins of under surface, 15–50 mm long, 4–20 mm wide, with 5–7 principal veins on each side of midrib; petioles 3–10 (15) mm long, glabrous to puberulent; stipules lance-deltoid, barely 1 mm long, deciduous, flowers 1 or 2 in upper axils; pedicels filiform, 2–5.5 cm long, glabrous to puberulent; ovary oblong-fusiform, 6–10 (12) mm long, 1 5–2 5 mm wide; hypanthium tubular, 8–10 (12) mm. long, glabrous or nearly so without, pubescent within; sepals narrowly lance-oblong, 15–25 mm long, 3–4 (5) mm wide, acuminate, mostly glabrous; petals obovate, 1–2 cm long, longer stamens 2–3.5 cm. long, epipetalous 4–6 mm. shorter; filaments filiform, glabrous; anthers 2–2 5 mm long; style slender, pubescent at base, mostly 3–5 cm long; stigma capitate, more or less lobed, 1 5–3 mm long, berry oblong, 1–2 cm long, 4–5 mm wide

This species is exceedingly variable, with a nomenclature much complicated by long culture in the garden and much hybridization. Many segregates have been proposed and many attempts have been made to classify such (cf. Philippi, Bot. Zeit, 34 577, 1876, Bailey, Cyclop Am Hort, 3 1301, 1915, for examples) In the study of wild plants the most that I can observe is (1) a tendency for larger flowers, larger thinner leaves, and longer pedicels in the more northern material, (2) opposite tendency in more southern material and (3) a possible less highly colored variety described by Prof Espinoza The complication involving hybridization with *F coccinea* and other species cannot be discussed here

KEY TO VARIETIES OF *Fuchsia magellanica*

A Hypanthium and sepals deep red, ovary and pedicels red.
  B Leaf blades mostly 15–25 mm long, pedicels 20–35 mm long 3a var *typica*
  BB Leaf blades mostly 25–50 mm long, pedicels 40–55 mm long 3b var *macrostema*
AA Hypanthium and sepals pink, ovary and pedicels green 3c var *Molinae*

(3a) **Fuchsia magellanica** Lam var **typica** Munz, new name

(Plate 1, fig 3)

F magellanica LAM, Encycl., 2 565, 1788, pl 282, fig 2, 1798
F gracilis var *multiflora* LINDL, Bot Reg, 13 pl 1052, 1827
F. gracilis var *tenella* LINDL, l c, *F. macrostema* var *tenella* DC, Prodr, 3 38, 1828, *F tenella* Hort, G. DON in Loud, Hort. Brit, 155, 1830.
F conica LINDL, Bot Reg, 13 pl 1062, 1827, *F macrostemma* var *conica* SWEET, Brit. Fl Garden, 6 under pl 216, 1833, *F magellanica* var *conica* BAILEY, Cyclop Am Hort., 614, 1900
? *F multiflora* LODD, Bot. Cab, 15 pl 1415, 1828.
F discolor LINDL, Bot Reg, 21 pl 1805, 1835, *F magellanica* var *discolor* BAILEY, Cyclop Am Hort, 614, 1900.
F coccinea var *robustior* HOOK, Fl. Ant, 2 269, 1847, based on Commerson coll in Strait of Magalhaens
F. chonotica PHIL., Linnaea, 28 687, 1856, Bot Zeit, 34.577, figs 4 and 5, 1876, *F. coccinea* var *chonotica* REICHE, Anal Univ Chile, 98 485, 1897, Fl Chile, 2 267, 1898
F araucana PHIL., Bot Zeit., 34 577, fig 6, 1876.
Dorvalla eucharis COMM ex Lam., Encycl, 2 565, 1788

Leaf-blades mostly 15–25 mm long, 4–10 (12) mm wide, somewhat coriaceous, often folded along the midrib, pedicels mostly 2–3 5 cm. long, red, hypanthium and sepals deep red, sepals 1 5–2 cm long, petals purplish, stamens 2–3 cm long, reddish

Type locality, "Commersón a observé cet arbrisseau sur les montagnes du Magellan, dans presque tous les bois, en Janvier 1768." The range of this variety is in Chile mostly south of Concepción, and in Argentina Representative material, "*F. magellanica* Lam dict Dorvalla Commerson herb.," Lamarck Herb. (P); *F. multiflora*, cult. hortul. Girod Geneva, in 1837 (NY), *F* *discolor,* H B Glasgow in 1850 (NY) , *F. tenella,* cult Lochowitz in 1845 (F) CHILE . Concepción San Vicente, *Pennell 12866* (GH) Arauco · Isl of St Mary's, *Eights* (US) Malleco Angol, *Kuntze in 1892* (F) Valdivia · Corral, *Gunckel 2* (F) , Cerro de la Marina, *Gunckel 5064* (POM) , Valdivia, *Buchtien in 1896* (GH) , Panguipulli, Hollermayer under *Werdermeyer 1364* (CAS, F, GH, NY, US) Llanquihue Ancud, Chiloé, *Pennell 12492* (F, GH) ; Isla Chiloé, near Castro, *Mexia 8009* (F ,GH, NY, US) ; Isla Chiloé, *Ruiz* (POM) , Peulla, *Pennell 12675* (F, GH, NY) ARGENTINA · Neuquen . Puerto Meyer, *Cabrera and Job 210* (NY) Río Negro . Lago Nahuelhuapi, *Ljungner 226* (NY) Patagonia Port Otway, *Lee in 1888* (US) ; Hassler Glacier, *Hill in 1872* (GH) , Eden Harbor, *Blake in 1872* (GH)

Intergrades with var *macrostema* are many, for example, with large leaves Valparaiso, *Wilkes Exped* (GH, NY, US) ; road from Curicó, Chile to Argentina, beyond Los Queñes, *Mexia 7863* (F, GH, NY, US) , Hualqui, Concepción, *Kuntze in 1892* (NY) , Aysen, Llanquihue, *Moreira in 1934* (POM) , Isla Victoria, Lago N Huapi, Argentina, *Burkart 6397* (F) , Lake Argentina, Santa Cruz, *Furlong 98* (GH, NY, US) Other intergrades in length of pedicels, etc , are Casa Panque, Llanquihue, Chile, *Shannon 25* (US) , Camino de Bariloche al Correntoso, Argentina, *Cabrera 5044* (F, GH, NY)

(8b) **Fuchsia magellanica** Lam var **macrostema** (R and P) Munz, new comb

F macrostema R and P , Fl Peruv 3 88, pl 324, fig b, 1802

F gracilis var *macrostema* LINDL., Bot. Reg , 13 under pl. 1052, 1827

F coccinea var *macrostema* HOOK., Fl Ant , 2 269, 1847

F coccinea CURTIS, Bot. Mag , 1 pl 97, 1789, not Ait

F decussata R GRAH , Edinb Phil Journ , 11 206 and 401, 1824 , SIMS in Bot Mag , 51 pl 2507, 1824, not R and P , 1802

F gracilis LINDL., Bot Reg , 10 pl 847, 1824, new name for Graham *F macrostemma* var *gracilis* SWEET, Brit Fl Gard , 6 under pl 216, 1833 plant (*decussata*) , *F magellanica* var. *gracilis* BAILEY, Cyclop Am Hort , 614, 1900

F macrostema var *recurvata* HOOK , Bot Mag , 63 3521, 1836 , *F recurvata* NIVEN ex Hook , l c

Thilcum tinctorium MOLINA, Sagg Chile, ed 2, 146, 1810

Leaf-blades mostly 25–50 mm long, 10–20 mm wide, membranaceous , pedicels mostly 4–5 5 cm long, red , hypanthium and sepals red , sepals 19–23 mm long ; petals purplish, stamens 30–35 mm long, reddish

Type locality, "Habitat in *Concepcionis Chile* locis uliginosis, praesertim in *Quebrada de Caramo* " Ranging mostly in Chile from Aconcagua to Concepción Representative material, without locality ,*F macrostemma, Gay 77,* Herb Mus Paris (F) CHILE . Aconcagua 15 km south of Valparaiso, *West 3980* (GH) Santiago Cordillera de Peñalolen, *Looser 2299* (POM) , Santiago, *Bro. Claude-Joseph 531* (NY, US) O'Higgins . Monte la Leona, Rancagua, *Bertero 280* (GH, NY) Curicó Cordillera Peteroa-Planchoa, Cañon Río Claro, *Mexia 04406* (GH). Ñuble Baños de Chillan, *Pennell 12473* (F, GH, US). Concepción Talcahuano, *C and I Skottsberg 1454* (NY) ; presumably from Quebrada de Carcamo, *Ruiz and Pavon,* as *macrostema,* Madrid Herb (photo F, POM) Bio Bio Pailahueque, *Padre Pwian 201* (GH) Cautin: Hotel Tolhuaca on road to Baños Calientes, *Morrison and Fagenknecht 17499* (GH) Magallanes Port Famine, *Lee in 1888* (F, US), Eberhard, *Donat in 1931* (CAS, GH, NY) ARGENTINA Terr del Neuquen Puerto Blest, *Bruch in 1898* (NY)

Intergrades have been discussed under var *typica*

(3c) **Fuchsia magellanica** Lam var **Molinae** Espinosa

Fuchsia magellanica LAM var *Molinae* ESPINOSA, Bol Mus Nac Chile, 12 102, 1929

Pedicels and ovaries greenish, hypanthium, sepals and stamens and style pink, corolla lilac-pink

Type locality, CHILE Prov Llanquihue Isla Chiloé, near Castro, Quebrada de La Chacra, type coll by *Espinosa, Jan 31, 1929* (SGO) Another collection seen from Isla Chiloé *F Flaminio Ruiz* (POM) Valdivia · Corral, *West 4846* (GH), *Gunckel 2133* (GH) Cultivated at Valparaiso, *Goodspeed 4589* (GH) There is some question as to whether this is a natural entity or a cultivated one, but it seems to be the former

(4) **Fuchsia coccinea** Soland

(Plate 1, fig 4)

Fuchsia coccinea SOLAND in Aiton, Hort Kew, ed 1, 2 8, 1789
F coccinea J D HOOKER, Bot Mag, 94 pl 5740, 1868
Nahusia coccinea SCHNEEVOGT, Icones, 21, 1793
Skinnera coccinea MOENCH, Meth Suppl, 270, 1802
Fuchsia elegans SALISBURY, Ic Stirp Rar, 13, pl. 7, 1791, said to come from Brazil
F pendula SALISBURY, Prodr, 279, 1796, cites plate and page in Stirp for *elegans*.
F pubescens CAMBESS, in St Hil, Fl Bras Merid, 2 275, pl 134, 1829
F montana CAMBESS, l c, pl 135
F Glaziouiana TAUB, Bot Jahrb 15, Beibl, 34 16, 1892

Shrub, bushy and up to 1 m tall, or semiscandent and 3 or more m tall, freely branched, the younger twigs very slender, scarcely 1 mm thick, subterete, densely puberulent, sometimes also pilose, more or less reddish, leaves opposite or in 3's, membranaceous, narrow-ovate, paler beneath, puberulent above and beneath, often also pilose beneath along main veins, rounded to cordate at base, subacuminate at apex, usually plainly serrulate, the blades with 4–6 main veins on each side of midrib, 15–45 (60) mm long, 10–20 (25) mm. wide, petioles mostly 1–3 mm long, frequently pilose, stipules lance-deltoid, less than 1 mm long, often reflexed, caducous; flowers solitary in upper axils, pedicels filiform, puberulent, sometimes scattered-pilose, 2–4 cm. long, ovary oblong, hypanthium red, subfusiform-tubular, glandular-puberulent without, sometimes with few long hairs, pubescent within, 4–6 mm long, ca 3 mm wide, sepals red, glandular-puberulent, oblong-linear to -lanceolate, acuminate, 15–20 mm long, connate at base for 3–6 mm, petals violet to purplish, obovate, 6–9 mm. long; episepalous stamens 15–30 mm long; epipetalous 2–5 mm shorter, anthers reddish, ca 2 mm. long; style pubescent at base, 2–4 cm long; stigma subentire, reddish, 1.5 mm. long; berry mostly oblong, about 1 cm. long.

Type locality Hooker (Bot Mag pl 5740) says · "The native country of the true *coccinea* is unknown; it is probably Brazilian, as it resembles the Brazilian more than the Western or Southern American species, Salisbury says it was introduced by Vandeli from Brazil, whereas Aiton attributes its introduction to Captain Frith, from Chile

"The evidence of the plant here figured being the true and original plant of Aiton's 'Hortus Kewensis,' ed 1, rests on the fact that named specimens of the same are preserved in the Banksian Herbarium of the British Museum, and in Sir J. Smith's Herbarium at the Linnean Society, all procured at Kew in the year of the introduction of the plant, and at the date of its being described by Aiton"

It takes some courage to apply the name *coccinea* to the Brazilian plant commonly passing as *pubescens* or *montana*, but I see no alternative These are the only *Fuchsias* which I can find that agree with all that Hooker says above and with specimens seen Material seen, WITHOUT LOCALITY · *F coccinea, Herb Steud.* (NY), *Meisner Herb* (NY), Hort Kew *M Ait* (G) BRAZIL So Brazil, *Glaziou 17614, F Glaziouviana* (fragment from Berlin and photograph at F, photograph at POM), without locality, *F pubescens* Camb, *St Hil C² 1545*, fragment from Mus Paris (F) Minas Geraes. *F montana* Camb, *St Hilaire*, fragment from Mus Paris, must be from Serra da Caraça, (F), Serra da Piedade, Municipio de Caeté, *Barreto 7160* (F), *8803* (F), *7162* (F), *7158* (F), Serra da Piedade, *Hoehne 6278* (POM), *6281* (POM) There is every intergradation from being merely puberulent as in the St Hilaire specimen of *montana*, through having some longer hairs at the base of the midrib, as in St Hilaire collection of *pubescens*, Hoehne 6278, 6281, Barreto 7160, 7162, 8803, to being pilose on the stems Barreto 7158, garden specimens from Herb Steudel, etc. The species has been naturalized in some places as in Jamaica Cinchona, *Nichols 60* (F, GH), *Harris 9130* (F) and Greenhill, *Harris in 1899* (F)

(5) **Fuchsia hybrida** Hort

Fuchsia hybrida Hort ex Vilmorin, Blumeng, ed. 3, Sieb. and Voss, 1:332, 1894, BEHRENS, Blattenformen, pl 71, fig. d, e, f, 1900
F speciosa Hort ex Bailey, Cyclop. Amer Hort, 614–615, 1900

Sturdy, with twigs usually reddish, leaves opposite, broadly ovate to oblong-ovate, rounded to cordate at base, apically acute, strongly serrulate, 3–5 cm long, 1 5–3 cm wide; petioles mostly 1–2 cm long; pedicels commonly 4–5 cm long; ovary ovoid, 6–8 mm long, 4–5 mm. wide; hypanthium 1–2 or more cm long, 4–6 mm wide; sepals 2 5–3 cm long, 8–11 mm. wide, petals 1–2 cm long; stamens included to exserted; style 4–5 or more cm. long; stigma 3–4 mm wide

Many many strains of the garden fuchsias, which are almost universally hybrid, are described more or less accurately by the above and are said by Bailey (Hortus, 264. 1930) to be "probably of hybrid derivation from forms of *F. magellanica* and *F. fulgens*."

(6) **Fuchsia regia** (Vand.) Munz, new comb.

Quelusia regia Vand. ex Vell., Fl. Flum., 149, 1825 and 4: pl. 6, 1827.

Semiscandent shrub up to 6 m. tall, freely branched, the ultimate branchlets slender, 1–2 mm. thick, flexuous, angled, dark red, glabrous to puberulent to pilose; leaves opposite or in 3's, oblong-ovate, entire to remotely and inconspicuously denticulate, coriaceous, rounded at base, more or less abruptly acuminate at apex (this usually not in same plane as rest of blade and somewhat folded in pressed specimens), glabrous to puberulent or pilose, often reddish on veins; blades mostly 4–10 cm. long, 2–4 cm. wide, with 5–7 main veins on each side of midrib; petioles 5–10 mm. long; stipules deltoid, about 0.5 mm. long, deciduous; flowers solitary in upper axils; pedicels almost filiform, 2–4.5 cm. long, glabrous to pubescent; ovary oblong; hypanthium deep red, cylindric, slightly enlarged toward apex, sometimes somewhat fusiform, 3–15 mm. long, 3–5 mm. wide, glabrous to pilose without and within; calyx red, glabrous to somewhat pilose, 13–35 mm. long, 4-lobed, the segments connate for 2–15 mm., the free segments lanceolate, spreading, 10–25 (30) mm. long, acuminate; petals purplish, obovate, obtuse, 10–15 (18) mm. long; episepalous stamens 20–35 (40) mm. long, epipetalous 16–30 (35) mm. long; anthers red, 2.5–3.5 mm. long; style somewhat pubescent at base, 3.5–5.5 (7.5) cm. long; stigma yellowish, or reddish, capitate, subentire, 2.5–3.5 mm. long; berry oblong or more spherical, 1.5–2.5 cm. long.

The name *regia* is based on a plate, which shows large leaves and flowers and a fusiform hypanthium, sepals connate a short distance. This combination of characters and the locality can mean only one thing: the species which has been called *F. integrifolia*. It is fair to admit that the plate shows the leaves more dentate than one would like.

Key to Varieties of *Fuchsia regia*

A. Young twigs shaggy-pilose; hypanthium 3–6 mm. long; calyx (united plus free portions) 13–21 mm. long. . . . 6d. var. *alpestris*

AA. Young twigs not pilose; hypanthium 7–15 mm. long; calyx 20–35 mm. long.

B. Young twigs densely and closely puberulent; connate portion of calyx 9–15 mm. long. . . . 6c. var. *affinis*.

BB. Young twigs essentially glabrous.

C. Connate base of calyx 2–5 mm. long; free segments 18–30 mm. long. . . . 6a. var. *typica*

CC. Connate base of calyx 9–14 mm. long; free segments 12–20 mm. long. . . . 6b. var. *radicans*.

(6a) **Fuchsia regia** (Vand.) Munz var. **typica** Munz, new name

(Plate 1, fig. 5)

Quelusia regia Vand. ex Vell., l.c.

Fuchsia integrifolia Cambess., in St. Hilaire, Fl. Bras. Merid., 2: 273, 1829; Bot. Mag., 68: pl. 3948, 1842; Micheli in Martius, Fl. Bras. 13, pt. 2: 174, pl. 37, 1875.

Glabrous except sometimes slightly and minutely puberulent about the young growth, pedicels 3–4 5 cm. long, hypanthium 7–15 mm. long; calyx 24–35 mm long, connate at base for 2–5 mm, free portion 18–30 mm. long

Type locality, "ad Alpes Pharmacopolitanas fruticetis, per quae ad oppidum Cunha iter fit," hence near the western end of the state of Rio de Janeiro, Brazil Ranging through the mountains of the states of Rio and Minas Geraes Material seen, BRAZIL without locality, *Burchell 2196* (GH), *Riedel in 1816* (GH), *Gardner 375* (NY) Minas Geraes · Ouro Prieto, *Cochran 29191* (US), Districto Carangola, trail to Areponga, *Mexia 4326* (F, CAS, GH, NY, US); top of Serra da Gramma, *Mexia 4278* (F, GH, NY, US), Caldas, *Claussen in 1840* (GH), *Regnell in 1878* (NY, US), Serra do Cipó, *Barreto 9254* (F), Serra do Caraça, *Barreto 7157* (F) Rio de Janeiro. Maceirras, Mt Itatiaya, *L B Smith 1476* (GH); near Rio de Janeiro, *Wilkes Exped in 1838–42* (NY), Organ Mts, *Wilkes Exped* (US)

Since this is the most common form of the species and is in the Organ Mts and since the original plate shows sepals slightly connate and does not show hair, I have to assume that this is typical *regia*

(6b) **Fuchsia regia** (Vand) Munz var **radicans** (Miers) Munz, new comb

F. radicans Miers in Bot Reg, 27 Misc no 167, and pl 66, 1841
F pyrifolia Presl, Symbol. bot., 2 19, pl 65, 1858

Glabrous throughout, pedicels 2–3 cm long, hypanthium 9–11 mm long, calyx 24–34 mm long, connate at base for 9–14 mm then free for 12–20 mm

Type locality, Organ Mts, Rio de Janeiro, Brazil. Material seen, BRAZIL Rio de Janeiro Organ Mts, *Miers 4453*, Feb, 1838 (US), Serra do Itatiaia Retiro, *Dusén 81* (GH, US) Paraná Serra do Mar, Desvio Ypiranga, *Dusén 6766* (GH)

(6c) **Fuchsia regia** (Vand) Munz var **affinis** (Camb) Munz, new comb.

F affinis Cambess, in St. Hilaire, Fl Bras Merid., 2 274, 1829

Young twigs densely and closely puberulent (leaves may be somewhat pilose on under surface along veins); pedicels 2–4 cm long, hypanthium 8–10 (13) mm long, calyx 20–30 mm long, connate at base for 9–15 mm, then free for 10–20 mm

Type locality, Serra da Boa Vista, Rio de Janeiro, Brazil Material seen from the states of São Paulo and Paraná BRAZIL without locality, *St Hilaire 22*, ex Herb Mus Paris (F). São Paulo Alto da Serra, at about 900 m, *L B Smith 1900* (F, GH), *Munz 15415* (F, NY, POM, US), Est Campo Grande, *Edwall 1957* (POM) Paraná · Curitiba, *Hoehne in 1928* (POM), *Dusén 14362* (F, GH, NY) A collection from Horto Botanico Cantareira, *Puttemans 204* (P) has the puberulence of *affinis* and the flower of *typica*.

(6d) **Fuchsia regia** (Vand) Munz var. **alpestris** (Gardner) Munz, new comb

F alpestris Gardner, Bot. Mag., 69 pl 3999, 1843
F. mollis Krause, Engl Jahrb., 37 600, 1906.

Young twigs densely shaggy-pilose, pedicels 2 5–4.5 cm long; hypanthium 3–6 mm long, glandular-pubescent and more or less pilose, calyx 13–21 mm long, connate at base for 2–6 mm, then free for 10–19 mm

Type locality, Organ Mts, Rio de Janeiro, Brazil Material seen, without locality, H B Glasgov, *F alpestris,* Sept, 1850 (NY) BRAZIL Minas Geraes Serra do Itacolomy, Municipio de Ouro, *Barreto 9168* (F), Itacolomi, Ouro Preto, *de Vasconcellos in 1901* (POM) Rio de Janeiro · bet Petropolis and Theresopolis, *Princess Therese von Bayern* in Herb Monacense (photos F, GH, POM); Organ Mts, *Gardner 5706,* type coll *alpestris* (NY), Nova Friburgo, *Ule 4418,* labelled *F integrifolia* var. *mollis,* a name seeming not to have been published, specimen at Rio and Berlin (photo F, POM) Paraná Porto de Cima, *Dusén 14133* (US) This entity approaches *F coccinea* in becoming dentate, but the pilosity is more dense, the leaves usually larger Barreto 9168 is quite like *regia typica,* but more toothed

SECTION 2 EUFUCHSIA Baillon

Eufuchsia BAILL, Hist Pl, 6 467, 1877, RAIMANN in Engler and Prantl, Die nat Pflanzen fam, III, 7 219, 1893
Fuchsia, as genus, L, Gen Pl, ed 5, 126, 1754, SPACH, Nouv Ann Sci Nat, (2), 4 177, 1835, as section, ENDLICHER, Gen Pl, 1193, 1840
Ellobium LILJA, Linnaea, 15 262, 1841

Flowers perfect, petals convolute Stamens erect, somewhat exserted or not, those opposite the petals shorter Fruit many-seeded Leaves opposite or whorled

Type species, *F triphylla* L

KEY TO SPECIES OF SECTION EUFUCHSIA

A Flowers axillary, that is borne in axils of ordinary or somewhat reduced foliage leaves
  B Hypanthium 3–30 mm long.
    C Hypanthium 3–5 mm long, shorter than the ovary, young twigs subglabrous Colombia. 51 *F verrucosa*
    CC Hypanthium 12–30 mm long, longer than ovary
      D Younger twigs, pedicels, etc, essentially glabrous (sometimes somewhat pilose about nodes), leaves mostly glabrous except sometimes along veins of under surface.
        E Petioles 5–20 mm long, sepals scarlet S Peru to Bolivia 52 *F sanctae-rosae*
        EE Petioles 20–35 mm long, sepals whitish, Ecuador 17 *F pallescens*
      DD Younger twigs, pedicels, etc., not glabrous.
        E Hairs on twigs and pedicels spreading, leaf blades mostly 5–12 cm long.
          F. Stamens conspicuously exserted, petals green, leaves with 7–9 principal lateral veins on each side of midrib Mexico to Costa Rica . 7 *F splendens.*
          FF. Stamens not exserted, petals red, lateral veins 10–15
            G. Leaves opposite, elliptic to obovate. Ecuador 50 *F scabriuscula*
            GG. Leaves mostly ternate, lanceolate to lanceovate. West Indes 23 *F. triphylla*

EE Hairs on twigs more or less appressed (if somewhat spreading, then leaf blades usually less than 5 cm. long); principal lateral veins mostly 3–10 on each side of midrib.

F Twigs pubescent, petioles mostly less than 1 cm long; hypanthium mostly less than 2 cm long.

G Sepals 7–12 mm. long. South America.

H Pubescence brownish; leaf blades usually not more than 3 times as long as wide, pale green beneath, serrate. Peru. . 48 *F decussata*

HH. Pubescence grayish; leaf blades usually 4 times as long as wide, whitish beneath, subentire to remotely serrulate Ecuador. 49 *F hypoleuca.*

GG Sepals 18–22 mm long West Indes 22. *F. Pringsheimii*

FF Twigs minutely puberulent, petioles 1–3 cm long, hypanthium 2–3 cm long Ecuador 16 *F loxensis*

BB Hypanthium mostly 30–70 mm. long

C Petals narrow, 2–3 times as long as wide

D. Young stems essentially glabrous except for the puberulence near the tips; style glabrous throughout, petals mostly glabrous

E Hypanthium 35–45 mm long, sepals long acuminate Peru and Bolivia

F The hypanthium 5–7 mm. wide at base, usually villous within, not much narrowed above, sepals with green tips, principal lateral veins 12–15 on each side of midrib . 10 *F denticulata*

FF The hypanthium 2–3 mm thick at base, then narrowed, sepals apparently red throughout.

G Principal lateral veins 7–10 on each side of midrib, hypanthium glabrous within, sepals 17–20 mm long Junin to to Cusco, Peru 11 *F leptopoda*

GG Principal lateral veins 13–15 on each side of midrib, hypanthium villous within, sepals 12–14 mm. long Amazonas, Peru. . 12 *F Woytkowskii*

EE Hypanthium 50–60 mm. long, sepals acute Colombia 13 *F magdalenae*

DD Young stems not glabrous, style more or less pilose on lower portion

E Hypanthium 7–11 mm wide at summit, petals frequently with some hair on backs, stems puberulent or villous, fruit 8–10 mm thick.

F. The young stems with fine ashy appressed puberulence, pedicels 15–25 mm long, fruit 8–10 mm. long, subglobose. Central Cordillera of Colombia . . 24 *F petiolaris*

FF The young stems ferruginous villous, pedicels 25–40 (60) mm long; fruit 12–15 mm long, ellipsoid Eastern Cordillera of Colombia. . . . . 25. *F Smithii*

EE. Hypanthium 5 mm. wide at summit, petals glabrous, fruit less than 8 mm thick Peru

F. Stems, etc., crisp pubescent, petioles 10–15 mm. long; petals obtusish Dept. Piura. . . . 25 *F Asplundii.*

FF Stems, etc, minutely appressed puberulent, petioles 4–8 mm. long; petals subacuminate Dept Amazonas...27 *F Llewelynii*

CC Petals wider, less than twice as long as wide.

D Young stems mostly glabrous, except sometimes toward tips; style glabrous or nearly so to its base.

E. Petals red. So. America

F Hypanthium 25–40 mm. long, leaf blades mostly 2–10 cm long, 1–3 cm wide, petioles 2–10 (15) mm long Peru 9 *F. austromontana.*

FF Hypanthium 60–70 mm long, leaf blades 8–18 cm long, 4–7 (9) cm wide, petioles 10–30 mm. long Ecuador 20 *F macrostigma*

EE Petals green Guatemala . 8. *F cordifolia*

DD Young stems hirtellous to pilose, style pilose or villous near base

E Twigs hirtellous with short subappressed hairs, petioles 1–5 (8) mm long, pedicels 1–2 cm long

F Leaf blades 2–4 cm. long, 1–2 cm wide, petioles 3–8 mm long Colombia and Ecuador 14 *F canescens*

FF Leaf blades 5–6 5 cm long, 2 5–3 cm wide, petioles quite lacking No Peru 15 *F rivularis*

EE Twigs pubescent to pilose, with spreading hairs, petioles 5–20 mm long, pedicels 15–45 mm long Ecuador and Peru.

F Hypanthium narrow, 2 mm thick at base, 5–6 mm wide at summit, sepals 10–12 mm. long, somewhat divergent Ecuador 18 *F Townsendii*

FF. Hypanthium wider, 3–5 mm thick at base, 7–11 mm wide at summit, sepals 15–22 mm long, spreading-reflexed

G Hypanthium gradually ampliate, hence widest at its mouth, sepals 3–4 mm wide, petals longer than wide Dept Apurimac, Peru 19 *F platypetala*

GG Hypanthium abruptly ampliate near middle and slightly narrowed at summit, sepals 5–6 mm wide, petals scarcely longer than wide Ecuador to Ayabaca, Peru 21 *F ayavacensis*

AA Flowers in clusters, making a definite inflorescence with bracts or leaves much reduced and different from foliage leaves

B Hypanthium 1–3 cm long

C. Young twigs essentially glabrous except for youngest tips

D Leaf blades generally at least 3 times as long as wide, hypanthium 13–16 mm long, petioles 2–4 mm long Colombia and N Ecuador 63 *F sessilifolia*

DD Leaf-blades usually 2–3 times as long as wide, hypanthium usually 16–30 mm long

E Leaf-blades mostly 5–8 cm long, 1 5–3 5 cm wide, style glabrous

F Flowers in elongate raceme like inflorescences, with more or less reduced foliage leaves S Peru and Bolivia 52 *F sanctae rosae*

FF Flowers in definite very short and compact racemes North of So Peru.

G Hypanthium 24–30 mm long, sepals 9–11 mm long, principal lateral veins on each side of midrib 8–12

H. Sepals oblong ovate, 5–6 mm wide, berry over 1 cm long, pedicels 15–25 mm long Peru 53 *F Osgoodii*

HH Sepals linear-lanceolate, 2 5–3 mm wide, berry 5–6 mm. long, pedicels 8–18 mm long Ecuador 55 *F Lehmannii*

GG Hypanthium 14–18 mm long, sepals 7 mm long, principal lateral veins about 15 Putumayo, Colombia. 56. *F putumayensis*

EE Leaf-blades mostly 8–20 cm. long, 3–9 cm. wide, with 12–18 principal lateral veins on each side of midrib, style pubescent near base

F. Petioles 2–8 mm. long; pedicels 5–7 mm. long; petals almost as wide as long, leaves quite glabrous. Ecuador. 61. *F. glaberrima*

FF Petioles 10–40 mm long; pedicels mostly 10–20 mm long; petals about 3 times as long as wide; leaves puberulent along veins underneath.

G Leaf-blades mostly obtuse at base; fruit ca. 6 mm. long. Colombia . 54. *F. Andrei.*

GG. Leaf blades subacuminate at base; fruit 8–10 mm. long. Peru 62 *F. macrophylla*

CC Young twigs definitely not glabrous.

D Leaf blades mostly 5–8 cm wide; pedicels 10–30 mm. long

E. Hypanthium 13–15 mm long; racemes mostly lateral; pedicels 10–15 mm. long. Húanuco, Peru. 31 *F ovalis*

EE Hypanthium 20–30 mm. long, racemes terminal, pedicels 15–30 mm. mm. long. Dept Cusco, Peru .34. *F tincta.*

DD. Leaf blades mostly 1 5–5 cm. wide; inflorescence often terminal.

E Stems with fine close appressed puberulence; hypanthium very narrow, scarcely bulbous at base, 14–19 mm long, 2 5–4 mm. wide at mouth. Colombia and Venezuela to Ecuador . . 64. *F. sylvatica*

EE. Stems pubescent to pilose; hypanthium somewhat bulbous at base.

F Hairs reddish 37 *F Storkii*

FF. Hairs not reddish.

G Flowers in terminal pyramidal panicles, hypanthium 14–20 mm. long Colombia 57 *F. Hartwegii*

GG Flowers in racemes.

H Twigs pubescent, hypanthium 15–20 mm long Santo Domingo and Haiti 23 *F. triphylla*

HH. Twigs pilose; hypanthium 20–25 mm long Peru.

I Bracts small, subulate or narrow, petioles of a given whorl subequal 59 *F asperifolia*

II Bracts more like reduced leaves, petioles of a whorl very unequal, one much exceeding the others 60 *F pilosa*

BB Hypanthium 3–6 5 cm. long

C. Leaves small, crowded, 12–16 mm long, stems with brown hair Peru 32. *F confertifolia*

CC Leaves larger, 30–200 mm. long

D Leaf blades narrow, more than 4 times as long as wide, in whorls of 4, linear lanceolate. Húanuco, Peru. .31. *F simplicicaulis*

DD. Leaf blades wider, 2–3 times as long as wide, opposite or ternate (sometimes quaternate in *F. hirtella*)

E. Petals (under a lens) puberulent to sparsely villous on back.

F. Sepals pubescent on inner or upper surface; fruit oblong, leaf-blades rigid. Colombia and Venezuela. 28 *F venusta.*

FF. Sepals glabrous on inner surface, fruit subglobose, leaf-blades membranaceous. Venezuela.

G Young stems appressed puberulent; pedicels 20–40 mm. long; hypanthium 35–40 mm. long, sepals spreading, 18–20 mm. long; petals strigulose on back .29 *F Jahnii*

GG Young stems glabrous or somewhat villous; pedicels 15–20 mm. long, hypanthium 40–50 mm. long, sepals divergent, 14–15 mm long; petals sparingly villous on back. 30. *F. Gehrigeri.*

EE. Petals glabrous on back

F. Young stems glabrous; leaves subglabrous above, puberulent beneath, petioles 2–8 mm. long

G Leaf blades 3 times as long as wide; principal lateral veins ca 20 on each side of midrib, pedicels 25–40 mm long Peru. . 43 *F abrupta*

GG. Leaf-blades less than 3 times as long as wide, principal lateral veins 10–12 on each side of midrib, pedicels 7–13 mm. long Colombia . 44. *F Cuatrecasasii*

FF. Young stems not glabrous under a lens.

G. The young stems finely puberulent

H. Principal lateral veins about 12 on each side of midrib, berry 5–6 mm long, pedicels 10–40 mm long. Colombia . 45 *F Killipii*

HH Principal lateral veins 14–24 on each side of midrib; berry 6–12 mm. long, pedicels 6–15 mm long

I Leaves quite glabrous, berry subglobose, almost 1 cm long Junin, Peru . 39. *F Munzii.*

II Leaves not glabrous under a lens; berry longer than thick.

J Leaf-blades densely soft puberulent, with 14–16 principal lateral veins on each side of midrib, style pubescent near base Ecuador to Húanuco, Peru 42 *F corymbiflora*

JJ Leaf blades glabrous on casual inspection, but minutely strigulose under a lens, with 18–24 principal lateral veins, style almost glabrous. Libertad, Peru 30 *F. Aspiazui*

GG The young stems pubescent to villous (very sparsely pubescent in *F fulgens*)

H. Stems and leaves pilose or villous with brownish or reddish hairs, pedicels 15–40 mm. long

I Sepals 15–20 mm long, hypanthium 35–45 mm long Bolivia 38 *F furfuracea*

II Sepals 8–12 mm long Peru

J Hypanthium 20–35 mm long, petioles 10–50 mm. long Cuzco 34 *F tincta*

JJ Hypanthium 40–45 mm long, petioles 2–5 mm. long.

K Leaves ternate, broadly elliptic Amazonas 35. *F Mathewsii.*

KK. Leaves opposite, oblong lanceolate. Cajamarca. . . 36 *F Fischeri.*

HH. Stems and leaves strigulose to pubescent; pedicels mostly 5–20 mm. long

I. Sepals red, pubescent on backs. Mostly So. American

J Sepals somewhat divergent; hypanthium strigulose without.

K. Leaves membranaceous, the apex in the same plane as the blade, berry over 1 cm. long. Central Colombia. 40 *F hirtella*

KK. Leaves rigid, rugose, the apex bent to

one side in pressing, berry less than 1 cm. long So Colombia and No Ecuador.
41. *F polyantha*

JJ Sepals spreading reflexed; hypanthium with spreading hairs West Indies and Central America to Argentina 46 *F boliviana*

II Sepals green, glabrous except for the sparse pubescence near the tips, divergent spreading. Mexico
47. *F fulgens*

(7) **Fuchsia splendens** Zuccarini

(Plate 1, fig 6)

Fuchsia splendens Zucc , Flora, 1832, ii, Beibl., 102, 1832
F splendens in Curtis, Bot Mag., 70 pl 4082, 1844, Bot Reg , 28 pl 67, 1842, Hemsley, in Bot Biol Centr Amer , 1 460, 1880
F cordifolia β Hooker, Icon Pl , 5 450, 1842
F intermedia Hemsley, Diag Pl Nov , 1 14, 1878, Bot of Biol Centr Amer , 1 457, 1880. Based on Hartweg 460 which I have not seen, but the characters given do not hold in a series of specimens

Shrub 6–25 dm tall, often pendant, sometimes a small tree, relatively few-branched, the ultimate branchlets usually pilose or pubescent, greenish to reddish, leaves opposite, ovate to ovate-cordate, paler beneath than above, membranaceous, more or less pubescent especially when young, acuminate, denticulate, the blades 3–10 cm long, 2–6 cm wide, with or without reddish tinge, principal lateral veins 7–9 on each side of midrib, petioles often tinged red, pilose to subglabrous, slender, 2–5 cm long, flowers solitary in axils or more or less crowded on short lateral branches with somewhat reduced leaves, pedicels nodding, subfiliform, pubescent, with some gland-tipped hairs, 3–5 (8) cm long, not much elongate in fruit, hypanthium 17–20 (40) mm long, somewhat compressed, the flattened side much broader than the ovary and gradually ampliate upward, 6–8 mm wide at base, 7–12 mm wide at summit, more narrow in other dimension, rose to bright red, externally pubescent with some hairs gland-tipped, internally pubescent-villous, sepals 4, green except for the sometimes reddish base, ovate-lanceolate, 8–15 mm long, 5 mm wide at base, pubescent, the tips scarcely free or free for 1 mm , petals green, ovate, subacuminate, 6–10 mm long, 4–5 mm. wide, episepalous stamens exceeding the sepals 10–18 mm long, epipetalous 8–16 mm long; filaments pale yellow, anthers yellow, 2–3 mm long, style glabrous, exceeding the stamens, stigma conoid, greenish-yellow, berry linear, 3–3 5 cm long, 5 or more mm thick

Type locality, "in imperio mexicano " Ranging from Chiapas to Costa Rica, at altitudes of 2000 to 10,000 feet Variable in pubescence, some plants being cinereous (Matuda 2322, Steyermark 36056, Pittier 10501, Standley and Valerio 43829), others with longer pubescence (Skutch 118, Pittier 44, Steyermark 32833) But there seems to be no geographical or other correlation with variability in pubescence There is also, at least in herbarium material, considerable variation in relative length and width of hypanthium. Curtis, Bot Mag 4082, mentioned the striking compression of the hypanthium, "so that in one direction, the diameter of the tube does not appear to be half what it is in another", this would account for some of the differences in herbarium specimens. However, material from Costa Rica has a long hypanthium which narrows appreciably at the summit, at least in Standley and Valerio 43829, Pittier 10501, not so much so in Stork 3024 Curtis shows such a condition in edge-view, but not in the flat view More material from Costa Rica may warrant nomenclatorial segregation

Representative material of *F splendens:* H B Basil, May 7, 1849 (NY); "F grandiflora N." *Sessé, Moçiño et al 5208* (F) MEXICO *F splendens* Zuccar ipse, Hab in Mexico, *Karwinski,* Herbarium Regium Monacense (photo F, GH, POM) Chiapas, without locality, *Ghiesbreght 698* (F, GH, MO), Mt Tacaná, *Matuda 2322* (F, MICH, NY); between San Cristóbal and Tenejapa, *Souviron and Erlanson 83* (US) GUATEMALA. San Marcos, Quebrada Canjulá, between Sibinal and Canjulá, Volcán de Tacaná, *Steyermark 36056* (F) Quiché, Chiul, Heyde and Lux, under *J D. Smith 2890* (NY, GH, US); Chimaltenango Chichavac, *Skutch 118* (US), Santa Elena, *Skutch 220* (US), Cerro de Tecpám near Santa Clara, *Standley 61000* (F, NY, POM), Volcán de Acatenango, above Las Calderas, *Steyermark 61808* (F) Sacatepéquez, Volcán de Agua, *J Donnell Smith 2174* (F, GH, NY, US), *Standley 65133* (F, POM), Jalapa, Montaña Miramundo, *Steyermark 32833* (F) COSTA RICA. prov?, Ojo de Agua, *Stork 3024* (F), Prov San José, Cerro de las Vueltas, *Pittier 10501* (US), *Standley and Valerio 43829* (F, US)

(8) **Fuchsia cordifolia** Bentham

(Plate 1, fig 7)

Fuchsia cordifolia BENTHAM, Pl Hartweg, 74, 1841; Lindl., Bot Reg, 27 70, 1841

Straggling shrub 1 m or so high, to a small tree, often epiphytic, few-branched, the younger branches somewhat red, subglabrous except toward the glandular-puberulent tips; leaves ovate to cordate-ovate, opposite, paler beneath than above, puberulent when young, nearly or quite glabrate in age, more or less abruptly acuminate, obscurely denticulate, blades thin, 3–9 cm long, 2–6 cm. wide, with 9–11 principal lateral veins on each side of the midrib, petioles 2–5 cm long, flowers solitary in axils of upper often somewhat reduced leaves; pedicels pendant, subfiliform, puberulent, 3–8 cm long at anthesis, not much longer in fruit, hypanthium subcylindric, dull red, puberulent without, some of the hairs gland-tipped, glabrous within, somewhat swollen at base, then slightly narrowed and somewhat broader only near the summit, 3 5–5 (6) cm. long, 4–5 mm wide except at the summit, where 7 mm wide; sepals mostly green except at reddish outer base, ovate-lanceolate, puberulent with some hairs gland-tipped, acuminate, 11–15 mm. long, 4–5 mm. wide at base, free tips 1–2 mm long, petals green to olive-green, broadly ovate, glabrous, acute to subacuminate, 6–8 mm. long, episepalous stamens about as long as sepals, epipetalous about two-thirds as long, anthers yellow, 2–2.5 mm long, style glabrous, slightly exceeding the sepals; stigma conic, 1 5 mm. long, fruit apparently linear-ellipsoid, more than 2 cm. long

Type locality, "In monte ignivomo Xetuch infra apicem, altitudine ped 10,000," prope Quezaltenango, Guatemala The species is known from elevations of 8000–11000 ft. from the mountains of Guatemala. It is distinguished from *F. fulgens* by its green petals and from *F. splendens* by its shorter stamens, the hypanthium being glabrous within and longer and subcylindric Specimens studied, GUATEMALA · Dept. San Marcos, Volcán de Tajumulco, between San Sebastián and Todos Santos, *Steyermark 36942* (F); Dept de Quezaltenango, Volcán de Zunil, *Steyermark 34686* (F); Cerro Quemado, *Kellerman 5953* (US); Volcán de Santa María, *Nelson 3723* (F, US), *Skutch 867* (F, NY), *Standley 67592* (F), *67648* (F); Xetuch, *Hartweg 528*, fragment of type number (F), photo of type no (F, POM); Dept Chimaltenango, San Martin, *Lewis 936* (F)

(9) **Fuchsia austromontana** Johnston

(Plate 1, fig 8)

Fuchsia austromontana Johnston, Journ Arnold Arboretum, 20 242, 1939
F. serratifolia Hook, Bot Mag, 71 pl. 4174, 1845, not of R. and P.

Loose bushy shrubs up to 4 m. tall, twigs reddish, 1 5–3 mm thick, glabrous except for the pilose tips; leaves opposite or ternate (or quaternate?), elliptic to elliptic-lanceolate or -ovate, acute to obtuse at base, acuminate at apex, serrulate, strigulose (at least along the veins) and light green on upper surface, paler beneath and villous on veins, rather fleshy, with 8–15 principal veins on each side of midrib, the submarginal vein often inconspicuous, blades 2–10 (12) cm long, 1–3 (4) cm. wide, upper ones considerably reduced, petioles 2–10 (15) mm long, villous, stipules lanceolate, 2–3 mm long, deciduous; flowers in upper axils, pedicels stoutish, 1–3 5 cm long, sparsely strigulose, ovary fusiform, sparsely strigulose, 8–10 mm long, 2–2 5 mm thick, hypanthium light red, subcylindric, 2 5–4 cm long, enlarged at base (3.5–5 mm thick), then narrowed for about 1 cm (i e 2–3 mm thick), then gradually wider toward summit (ca. 7 mm wide), sparsely villous without, villous within lower portion; sepals red, lanceolate, 15–17 mm long, 4 mm wide, subacuminate (bud subacuminate, but scarcely apiculate), pubescent to villous without, glabrous within, petals broadly obovate, rounded at apex, 14–15 mm long, 11–12 mm wide, red, sometimes purple on drying, stamens 16–17 and 10–11 mm. long; anthers 4–5 mm long; style glabrous, 2–3 mm longer than sepals, stigma 2–3 mm. thick; berry broadly ellipsoid, about 15 mm. long, 8 mm. wide.

Type locality, between Pillahuata and Acanacu, prov Paucartambo, dept. Cuzco, Peru Near to *F. denticulata* in the broad hypanthium and glabrous style and to *F cordifolia* in the broad hypanthium-base. It seems to be rather local in Paucartambo; I have seen the following collections: PERU: Paucartambo · between Pillahuata and Acanacu, at 2800 m., *West 7083*, isotype

(GH), Pillahuata, Cerro de Cusilluyoc, 3000–3300 m. *Pennell 14110* (F, GH, US); Cabecera de Montaña, camino a Tambomayo, 2000 m., *Vargas 10-7083* (F); between Achirani and Medias-Mayu, 2600 m., *Vargas 11121* (F), Accanaco, 4000 m, *Balls 6708* (US)

(10) **Fuchsia denticulata** Ruiz and Pavón

(Plate 2, fig 9)

Fuchsia denticulata RUIZ and PAVÓN, Fl Peruv, 3 87, pl 325, fig b, 1802

F serratifolia RUIZ and PAVÓN, l.c., 86, pl 323, fig a. Since this name has page priority, I had intended to use it, but must follow Art 56 of the International Rules, since Macbride took up this name (Field Mus Nat Hist. Bot. Ser, 13, part 4.553, 1941).

F. tacsoniiflora KRAUSE, Fedde Rep Nov Sp, 1 172, 1905, based on Weberbauer 252, which seems to belong here

F grandiflora RUIZ ex Dahlgren, Field Mus. Nat Hist Bot Ser, 21 212, 1940, *nomen nudum*. Have seen photograph of Geneva specimen (F, POM).

Semiscandent shrub to tree, up to 12 m tall, the young twigs green to reddish, mostly 3–5 mm thick, subterete, mostly glabrous, more or less puberulent or pubescent toward tips, about younger nodes, etc, leaves opposite or ternate, elliptic to oblong, rather fleshy, subentire to somewhat serrate, acute to obtuse at base, acute to acuminate at apex, darker above than beneath, subglabrous to puberulent above, subglabrous beneath or somewhat villous along veins, the principal lateral veins 12–15 on each side of midrib, submarginal vein evident; blades 4–11 cm long, 2–4 (5) cm wide, petioles 5–15 mm long, 1–2 mm wide, glabrous to pubescent; stipules lance-deltoid, ca 1 mm long, deciduous, flowers solitary in axils of upper somewhat reduced leaves, pedicels rather stout, 1 5–4 cm long, usually minutely strigulose, ovary subfusiform, 10–12 mm long, 2–3 mm wide, minutely strigulose, hypanthium tubular, red, 3 5–4 cm long, 5–7 mm wide at base, very little narrowed, then very gradually widened toward mouth where 7–10 mm wide, subglabrous to sparsely villous without, usually densely villous within lower portion, sepals red with green tips, lanceolate, divaricate, 18–24 mm long, 4–5 mm. wide, acute to acuminate (bud acuminate) in the terminal 3–4 mm but scarcely apiculate, glabrous to somewhat villous on backs, glabrous on inner surface; petals crimson to scarlet, oblong to oblong-lanceolate, acute to obtuse, 15–17 mm long, 4–6 mm wide, glabrous, stamens 17–20 and 13–16 mm long, glabrous; anthers white, 4–5 mm long; style stout, glabrous, equalling or exceeding sepals by a few mm.; stigma white, subglobose, ca. 3 mm. thick; berry ellipsoid, 16–19 mm. long, ca 8 mm thick, subglabrous to minutely strigulose.

Type locality, Muña, dept. Húanuco, Peru With *F. leptopoda*, etc this species forms a long-tubed, axillary-flowered group related to *F cordifolia*, *F. austromontana*, etc. I am unable to separate *F serratifolia* and *F denticulata*, type material of both of which has been available. They are characterised by their stout twigs, fleshy, elliptic subglabrous leaves, tubular hypanthium, non-apiculate buds, ellipsoid berry. Found in Peru and Bolivia; representative material as follows: *F denticulata*, ex Herb Madrid, *Ruiz and Pavón*, type material (F), photograph of Geneva material (F, POM), *F. serratifolia* ex Herb Madrid, *Ruiz and Pavón*, type material (F), photograph (F, POM); *F grandiflora*, photograph of Geneva specimen (F, POM) PERU · Húanuco, 15 mi se. of Húanuco, 3200 m, *Macbride and Featherstone 2082* (F, GH, US); Mito, 2800 m, *Macbride and Featherstone 1403* (GH, F, US), west of Carpish, *Stork and Horton 9893* (F); Muña, trail to Tambo de Vaca, 2500 m., *Macbride 4284* (F, GH, US), Carpis, between Acamayo and Chincháo, 2800 m, *Mexia 04127* (GH); Lima to Oroya, 3200 m, *Weberbauer 252*, type *tacsoniiflora* at Berlin (photo F, POM); Río Blanco, Lima at 3600 m., *Macbride and Featherstone 723* (F, GH); Quebrada de San Mateo, *Isern 2546* (F) Ayacucho, Prov Huanta, Choimacota Valley, 2900 m, *Weberbauer 7587* (F, GH, US). Huancavelica · Prov Tayacaja, Montifungo, east of Surcubamba, 3000 m., *Stork and Horton 10367* (F), Salcabamba, 3250 m, *Stork and Horton 10261* (F) Cuzco Prov. Paucartambo, Río Tambomayo, 1700–2000 m, *West 7093* (GH) BOLIVIA · La Paz Nor Yungas Unduavi, 3000 m, *Eyerdam 25137* (F), Sur Yungas Unduavi, 3100 m, *Buchtien 143* (F, GH, NY), *2923* (NY, US), Yungas, *Bang 731* (F, GH, NY, US), *Rusby 1801* (NY), Combaya, Prov Larecaja, 3000–3300 m, *Mandon 623* (GH).

(11) **Fuchsia leptopoda** Krause

(Plate 2, fig 10)

Fuchsia leptopoda KRAUSE, Fedde Rep, Nov Sp, 1 171, 1905.
F. siphonantha KRAUSE, l c., 173

Scandent to erect shrub, up to 3 m tall, the twigs dark, glabrous to strigulose toward tips, terete, 1–3 mm thick, leaves opposite or ternate, elliptic-lanceolate or -oblanceolate, acute at base, acuminate at apex, serrulate above, light green and glabrous or strigulose on veins, paler beneath and glabrous except for pilose veins, the principal lateral veins mostly 7–10 on each side of midrib, the submarginal vein more or less developed, blades 4–9 cm long, 1 5–2 5 (3) cm wide, petioles slender, 5–15 mm long, somewhat pubescent; stipules lanceolate, 3 mm long, deciduous; flowers in axils of often reduced foliage leaves, pedicels slender, subglabrous, 3–5 cm long; ovary fusiform, glabrous to puberulent, 5–8 mm long, hypanthium dark red, tubular, 3 5–4 5 cm long, somewhat bulbous at base and ca. 3 mm thick, then narrowed to width of 1 5–2 mm for about 1 cm, then widened toward mouth where 6–7 mm wide, glabrous to sparsely villous without, densely villous within lower portion; sepals deep red, lance-linear, 17–20 mm long, 3 5–4 mm wide, acuminate (bud very slender and long-acuminate, with tip 4–5 mm. long), glabrous to pubescent on back, glabrous within, petals fiery red, oblong, 17–18 mm long, 4–7 mm wide, acute, glabrous or sparsely villous on back near base, stamens 18–22 and 12–15 mm. long, glabrous; anthers 3–4 mm. long; style glabrous, equalling sepals or exceeding them by 1 cm., stigma subglobose, obscurely lobed, 2–3 mm wide, fruit narrow, over 1 cm long

Type locality, PERU. Junin. Prov Tarma, between Huacapistana and Palea I have seen the following examples PERU Junin Prov Tarma between Huacapistana and Palea, 2200–2500 m, *Weberbauer 1772*, type at Berlin (photo at F, POM), Montibus ab Huacapistana ad orientem versus, 2600–2700 m, *Weberbauer 2178* type *siphonantha* at Berlin (photo F, POM) Ayacucho. Prov. De La Mar between Tambo and the Apurimac, Yanamonte, 2700–2800 m, *Weberbauer 5641* (F, GH, US), Prov Huanta, Choimacota Valley, 2900 m, *Weberbauer 7587a* (F, GH) Cuzco Paucartambo · Tres Cruces, above Cosñipata, *Weberbauer 6934* (F, GH, US) In general, this species is very near to *F denticulata* but with a more narrow tube and leaves, long-pointed buds, etc

(12) **Fuchsia Woytkowskii** Macbride

(Plate 2, fig 11)

Fuchsia Woytkowskii MACBRIDE, Field Mus Nat. Hist, Bot Ser, 13 part 4 566, 1941

Shrub up to 4 m tall, the young twigs glabrous, purplish red, slender, leaves opposite or ternate, elliptic-lanceolate to -ovate, acute at base, acute to acuminate at apex, subentire, rigid, dark and glabrous above, somewhat paler and glabrous beneath except for the minute appressed puberulence on the veins, principal lateral veins 13–15 on each side of the midrib, submarginal vein evident, blades 4–8 cm long, 1 5–3 cm wide, petioles 3–6 mm long, stipules subulate, 2 mm long, deciduous, flowers solitary in axils of upper leaves or apparently subterminal on short branches, pedicels purplish, subfiliform, nearly glabrous, 1–2 5 cm long, ovary fusiform, 5–6 mm long, 2 mm wide; hypanthium deep vermilion, 3.5–4 7 cm long, bulbous at base, 2–2 5 mm wide, then narrowed for one-third its length then gradually widened until 6–7 mm wide at mouth, glabrous without, pilose within the basal two-thirds, sepals vermilion, spreading, 12–14 mm long, 4–5 mm wide, glabrous, subulate for 2–3 mm at apex (the tips apparently not connivent in the bud), petals bright red, oblong-elliptic, 12–13 mm long, glabrous, erose-rounded at apex; stamens 10 and 8 mm long, anthers 2 mm long, style glabrous, surpassing sepals by 2–3 mm, stigma 2 mm thick ,

Type, PERU Dept Amazonas near Almirante, at 1900 m, *F Woytkowski* (F) This one and only specimen is rather inadequate, but apparently does not fit into any of the previously described species It seems near *F leptopoda*, but the hypanthium is more slender and not glabrous within, and the sepals are shorter and with free tips in the bud

(13) **Fuchsia magdalenae** Munz, new species

(Plate 2, fig 12)

Shrub; young twigs glabrous, purplish, 1 5–3 mm. thick; leaves opposite, ternate or quaternate, coriaceous, elliptic, rounded at base, abruptly acuminate at apex, inconspicuously denticulate, quite glabrous except for the ciliate margins, somewhat paler beneath than above, principal lateral veins dark, 8–10, the submarginal vein more or less distinct; blades 3–6 cm. long, 1.5–2 5 cm wide, the upper reduced; petioles dark, glabrous, 5–6 (10) mm long; stipules subulate, 1 mm long, deciduous, flowers solitary in upper axils, subfiliform, glabrous, 4–5 cm long, dark; ovary glabrous, 7–11 mm. long, 2–2.5 mm wide, hypanthium purplish at base, brighter red beyond, 5–6 cm long, about 4 mm wide at base, then not constricted but tubular and gradually enlarged until 8–9 mm wide at mouth, glabrous without and within, sepals lance-oblong, 16–19 mm. long, 4 5–5 mm. wide, red, glabrous, acute, not subulate at apex, petals scarlet, oblong-ovate, 15–18 mm. long, 7–8 mm wide, acutish, stamens 17 and 13 mm long; anthers 3 5 mm long; style slender, glabrous, exceeding sepals by 5–6 mm , stigma 4-lobed, 4 mm. wide; berry ellipsoid, ca 17 mm long, 8 mm. wide

Frutex, ramulis glabris, subpurpureis, 1.5–3 mm diametro, foliis oppositis, ternatis vel quaternis, coriaceis, ellipticis, basi rotundatis, apice abrupte acuminatis, subglabris, laminis 3–6 cm. longis, 1 5–2 5 cm. latis; petiolis glabris, 5–6 (10) mm. longis, stipulis subulatis, 1 mm longis, caducis, floribus solitariis in axillis superioribus; pedicellis subfiliformibus, glabris, 4–5 cm. longis, ovario glabro, 7–11 mm longo, hypanthio rubro, 5–6 cm. longo, basi 4 mm lato, tubuloso, supra 8–9 mm. lato, extus intusque glabro, sepalis lanceolato oblongis, 16–19 mm longis, 4.5–5 mm. latis, rubris, glabris, acutis, petalis coccineis, oblongo ovatis, 15–18 mm longis, 7–8 mm. latis, subacutis, staminibus 17 vel 13 mm longis, antheris 3 5 mm. longis, stylo glabro, sepala excedente, stigmate 4-lobato, bacca ellipsoidea, ca 17 mm longa, 8 mm. lata.

Type Colombia Dept. Magdalena: above San Miguel, at edge of páramo, 3000 m., July, 1932, *Seifriz 392*, United States Nat Herb no 1572275 A second collection from the same department is from between Pueblo Viejo and San Miguel, 900–1700 m , *Seifriz 537* (US). The proposed species is related to *F. denticulata* in its tubular hypanthium; it is characterized by its long hypanthium, thickish leaves, glabrous condition, non-acuminate sepals and northern range.

(14) **Fuchsia canescens** Bentham

(Plate 2, fig 13)

Fuchsia canescens BENTH , Pl Hartweg , 178, 1845.
F corollata BENTH , l.c , 179 Type number seen.
F. vulcanica ANDRÉ, Rev Hortic., 233 and 268, 1888; from Volcán de Azufral, type not seen, but characters as given agree.

Erect or clambering shrubs up to 3 m tall, freely branched, the young twigs terete, dark, hirtellous with more or less appressed short hairs, leaves opposite, ternate or quaternate, crowded, coriaceous, often with revolute margins, elliptic-ovate, obtuse or rounded at base, obtuse to acute at apex, serrulate, dark green and pubescent to glabrescent above, paler beneath and pilose on veins, sometimes more generally, the principal lateral veins mostly 4–7 on each side of the midrib, submarginal vein often not conspicuous; leaf-blades 2–4 cm long, 1–2 cm. wide; petioles 3–5 (8) mm. long, pubescent; stipules lance-subulate, 1–1.5 mm. long, deciduous; flowers axillary, pedicels slender, pubescent, 1–2 cm long; ovary ellipsoid, pubescent, 5–6 mm long; hypanthium deep scarlet, purplish at base, 3 5–4 5 cm long, bulbous at base and 2.5–3 mm. thick, then abruptly narrowed to 1–2 mm for one-third its length, then rather gradually widened until 6–7 (9) mm. wide at summit, more or less pilose without, pilose within the lower half or almost throughout; sepals deep scarlet, more or less divergent to almost spreading, 10–16 mm long, 4–5 mm wide, acuminate, with subulate tips about 1 mm long, pilose without, glabrous within; petals scarlet, sometimes drying purplish, rhombic-ovate to -obovate, acute to obtuse or almost rounded at apex, from about as long as to exceeding sepals, 10–16 mm long, 6–12 mm wide, stamens 10–12 and 7–8 mm long; anthers 1 5–2 mm long; style pilose within much of the hypanthium, about as long as sepals, stigma scarlet, about 2 mm thick, fruit apparently ellipsoid

Type locality, ascent to Páramo Guanacas, near Popoyan, Cauca, Colombia. Extending from Calda, Colombia into Ecuador Representative material, COLOMBIA · Caldas Páramo del Quindio, 3800–4000 m, *Pennell and Hazen 10058* (GH, NY) Antioquia · Páramo de Ruiz, 2800–3300 m, *Lehmann 3067* (US Cauca · Páramo de Buena Vista, Huila group, central Cordillera, 3100 m, *Pittier 1188* (US), ad Páramo Guanacas, near Popoyan, *Hartweg 992,* type no *canescens* at Geneva (photo F, POM, leaf F), in sylvis Purace, 3100 m, ad Páramo de Guanacas, near Popoyan, *Hartweg 993,* type no *corollata* at Berlin (Photo F, POM, leaves F) Nariño Volcán de Galera above Pasto, 2600–2800 m, *Lehmann 5615 B* (F), Altos Caballos, 3000 m, *Triana 3808* (US) ECUADOR. Carchi · Nudo de Boliche, Voladero, 4000 m., *Penland and Summers 915* (F, POM), Canton Tulcan, road Tulcan to Pun, 3200 m, *Mexia 7584* (POM, US), Páramo del Azufral, east of Angel, *Mexia 7512* (NY, US) Bolívar Simiatuz · Hacienda Talahua, 3200 m, *Penland and Summers 623* (F, POM) Tungurahua · Páramo de Minza, Minza Chica, 3800 m, *Penland and Summers 337* (F, POM)

F canescens comes in a broad-petaled group which seems to me to be related to the *F cordifolia* group in its broad hypanthium-base and in having the hypanthium quite inflated in its upper third The species is near *F ayavacensis* but differs in the smaller thicker leaf-blades, shorted pedicels, the petals nearly as long as or longer than the sepals, the latter being shorter and more spreading than in *ayavacensis* There is some question as to whether my treatment of *canescens* is too inclusive; *Penland and Summers 623,* and *915* and *Mexia 7512* having the petals rather round and shorter than the sepals, *Hartweg 992, Pittier 1382,* and *Penland and Summers 623* having the upper surface of the leaves finely strigose But the whole range of variation seems such as not to make possible a taxonomic differentiation with the amount of material available. The leaves from the type collections of *canescens* and *corollata* are quite alike

(15) **Fuchsia rivularis** Macbride

Fuchsia rivularis MACBRIDE, Candollea, 8 24, 1940, Field Mus. Nat Hist, Bot. Ser., 13, part 4:568, 1941.

Branchlets puberulent; leaves ternate, ovate-elliptic, abruptly acuminate, entire, glabrous above, loosely pilose beneath, the blades 5–6.5 cm long, 2.5–3 cm wide; petioles lacking or nearly so; flowers solitary in axils of somewhat reduced upper leaves; pedicels 1 cm. long, hypanthium 4 5 cm long, sparsely puberulent without, pilose within lower portion, gradually ampliate; sepals narrowly lanceolate, long-acuminate, 2 cm long, petals oblong, about as long as sepals, stamens shorter.

Based on a Mathews collection from Chachapoyas, Amazonas, Peru and said to be near *F ayavacensis* or *F hirtella,* but with narrower petals and more sessile and wider leaves I have seen no material nor photographs, but except for the larger leaves and longer petioles it seems much like *F canescens*

(16) Fuchsia loxensis H B K

(Plate 2, fig 14)

Fuchsia loxensis H.B K, Nov. Gen et Sp, 6 106, pl 536, 1823
F umbrosa Benth, Pl Hartw, 176, 1845, I have seen a photograph of the type
F apiculata Johnson, Contr Gray Herb, 75 34, 1925 Type seen

Shrub, slender, stiff and bushy or more or less scandent or leaning, commonly up to 2 or 3 m tall, the younger twigs slender, 1–3 mm thick, purplish red, loosely appressed-puberulent, with whitish or yellowish hairs, leaves opposite to ternate, sometimes quaternate, firm, elliptic to elliptic-oblong, rounded to acute at base, mostly acute at apex, subentire to remotely denticulate, shining, deep green and minutely appressed-puberulent to glabrescent above, paler and puberulent beneath, also more or less pilose beneath especially along or near the midrib, principal lateral veins often reddish beneath, prominent, about 10 on each side of the midrib, the submarginal vein present; leaf-blades 2 5–6 (7) cm long, 1 2–2 (3) cm wide, petioles slender, strigulose, 1–3 cm long; stipules subulate-deltoid, 1–2 mm long, deciduous flowers solitary in axils, pedicels slender, strigulose, and sometimes pilose, 1–2 5 cm long, ovary ellipsoid, strigulose, 3–5 mm long; hypanthium deep red, 20–25 (30) mm long, the base 2–3 mm thick, then very slightly narrowed, then gradually widened until 5–6 mm wide at the mouth, shining and somewhat strigulose without, densely white-pubescent within the lower half, sepals scarlet, lance-oblong, 8–10 mm long, 3 5–4 mm wide, divergent, puberulent to sparsely pilose, the subulate tips about 1 mm long, petals ovate, dull red, 6–9 mm long, 5–6 mm wide, obtuse; stamens 7–8 and 5–6 mm long, anthers 2 mm long, style pubescent in lower part, red, exceeding sepals by 3 5 mm, stigma 2 mm wide, fruit ellipsoid, 8–15 mm long, 5–6 mm thick

Type locality, near Loja (Loxa), Ecuador The species is apparently confined to the highlands of Ecuador, growing at from 2000-3400 meters Representative material seen, ECUADOR without definite locality Eastern Cordillera, *Rimbach 6* (GH, NY, US), in Andibus Ecuadorensibus, *Spruce 5203* (GH, NY) Pinchincha: Hacienda de Pinantura near Quito, *Hartweg 983,* type no *umbrosa* at Geneva (photo F, POM); near Tambillo, *Penland and Summers 959* (F, POM), Quitig-Tesalia (Machachi), *Firmin 666* (F, GH, US) Leon: Cotopaxi road Pilaloa to Macuchi, *Haught 2955* (POM, US)

Tungurahua. west of Ambato, *Heinrichs 828* (NY), south of Baños, *Penland and Summers 93* (F, POM) Bolívar Simiatug Hacienda Talahua, *Penland and Summers 520* (F, POM) Azuay and Cañar · between Cuenca and Huigra, *Hitchcock 21667*, type no *apiculata* (GH, NY, US) Loja mts near Loxa, *Hartweg 733* (NY); F loxensis, *Humboldt* in Willdenow Herbarium at Berlin (photo, F, POM)

F loxensis seems near to *F canescens* in its leaves, broad petals, etc, but has shorter hypanthia and somewhat narrower petals, *Spruce 5203*, above cited, is quite intermediate It is near *F decussata* in some ways, but has longer hypanthia, less serrate leaves and less evident stamens

(17) **Fuchsia pallescens** Diels

Fuchsia pallescens DIELS, Notizbl d bot Gart u Mus zu Berlin Dahlem, 14 34, 1938.

Medium sized shrub, younger branches subglabrous; leaves opposite or ternate, membranaceous, subovate, subacuminate at both ends, callous-denticulate, almost glabrous, blades 6–7 cm long, 3 5–4 cm wide, petioles 2–3 5 cm long, flowers axillary, but arranged subcorymbosely near tips of branches, pedicels 8–15 mm long, ovary attenuate at apex, hypanthium pale carmine, 2 cm long, nodose at base, then constricted, then gradually widened until 4 mm wide at mouth, glabrous without, sepals white, lanceolate, very acute, 10–12 mm long, 3 mm wide at base, petals purplish, 6–7 mm long; style with globose stigma.

Type locality, ECUADOR Prov Tunguragua east of Patate, montane forest above Leito at 2750 meters I have seen no material, but the plant would seem to be near *F loxensis* and distinct from it in being more glabrous, having wider more plainly toothed leaves, and in its white sepals

(18) **Fuchsia Townsendii** Johnston

(Plate 3, fig 15)

Fuchsia Townsendii JOHNSTON, Contr Gray Herb, 75 33, 1925.

Shrub, the young twigs purplish, densely spreading-pubescent, leaves crowded, ternate, elliptic-oblanceolate, membranaceous, acute at base, acuminate at apex, remotely denticulate, green and sparsely and finely pubescent above, paler and densely canescent-villous beneath, the principal lateral veins 10–12 on each side of midrib, blades 6–13 cm long, 2–3 cm wide, petioles pubescent, 5–20 mm long, stipules subulate, 1–2 mm long, deciduous; flowers few, axillary, pedicels slender, pubescent, 1 5–2 5 cm long, bulbous at base where 2 mm thick, then narrowed for one-third its length to 1 5 mm, then gradually widened to 5–6 mm at mouth, densely pubescent without and within the lower half; sepals 10–12 mm. long, ascending, lanceolate, acute, 4 mm wide, pubescent on back, glabrous on upper or inner surface, petals ovate, 9–10 mm long, 8 mm wide, obtuse, stamens 13 and 9 mm long; anthers 3 mm. long; style pubescent in lower part, slender, not exceeding sepals, berry hairy, narrowly ellipsoid, over 1 cm long

Type locality, Sabiango Hill, Ecuador, type collected by *C H Townsend*, number *A93* (type at US, fragment GH). The type collection is the only material I have seen, it is distinct in its large thin hairy leaves, long narrow hypanthium and short sepals and petals *F. Scherffiana* André (Rev. Hortic., 1888, 233, 268) may be an earlier name for this species, but since I have not seen certain material I am not sure as to width of petals

(19) **Fuchsia platypetala** Johnston

(Plate 3, fig 16)

Fuchsia platypetala Johnston, Journ. Arnold Arbor., 20 241, 1939.

Shrub 2–3 m tall, the younger branches 2–4 mm thick, terete, somewhat reddish, pubescent; leaves opposite or ternate, elliptic-lanceolate, membranaceous, acute at both ends, serrulate, pilose-pubescent on both surfaces especially when young, principal lateral veins 8–11 on each side of midrib, with submarginal vein present; blades 2.5–7.5 cm long, 1–2.3 cm wide, petioles slender, 4–15 mm long, pilose, stipules subulate-deltoid, ca 1 mm long, flowers in upper axils; pedicels slender, 2–3.5 cm long, somewhat pilose, ovary ellipsoid, 8–10 mm long, pilose, hypanthium red, 4.5–5 cm long, bulbous at base where 3–4 mm thick, then 2–3 mm wide for one-third its length, then gradually widened until 8–9 mm wide at mouth, sparsely pilose externally, densely so within for two-thirds its length, sepals lanceolate, crimson, 15–20 mm long, 3–4 mm wide, apiculate for 2–3 mm, sparsely pilose without, glabrous within, petals crimson but with central white oblong blotch, obovate, rounded or broadly obtuse, 14–16 mm long, 10–12 mm wide, stamens 16–17 and 12–13 mm long, anthers 3 mm long, style pilose through most of its length, reddish; stigma slightly lobed, 3 mm thick.

Type locality, Chincheros, Apurimac, Peru Material seen, PERU Dept Apurimac · Chincheros, at 2930 m, *West 3705* (GH, type) Cuzco, cultivado en los jardines, *Herrera 1514* (GH) The plant would seem in its wide-based hypanthium to be in the ***denticulata, austromontana, leptopoda*** group but differs in its hairy style, thinner leaves, wider petals, and whitish blotch on each petal

(20) **Fuchsia macrostigma** Bentham

Fuchsia macrostigma Bentham, Pl Hartw, 129. Dec, 1844

Erect shrub, 0.5–1.5 m tall, apparently rather openly branched, the young twigs green to reddish, herbaceous, terete or angled, 1.5–3 mm thick, glabrous to pubescent; leaves opposite, membranaceous, broadly to narrowly elliptic, acute to obtuse at base, abruptly acute to subacuminate at apex, obscurely denticulate, ciliate, dark green and subglabrous to puberulent above, lighter and subglabrous to puberulent beneath, purplish on veins, principal lateral veins 12–16 on each side of midrib, submarginal vein developed; blades 8–18 cm. long, 4–7 (9) cm wide; petioles 1–3 cm. long; stipules deltoid, 2–3 mm long, more or less persistent; flowers solitary in upper axils; pedicels coarse, ascending, 1–2 cm long; ovary linear, 6–10 mm. long, 2–3 mm. thick; hypanthium tubular, reddish purple, especially on lower half, 6–7 cm long, 2–3 5 mm. thick at base, then very slightly narrowed for one-third its length and gradually widened to 6–8 mm at mouth, puberulent to pilose without, glabrous within; sepals lance-oblong, purplish red or lighter, spreading, 16–23 mm. long, 7–8 mm wide, subulate for about 2 mm. at tip, pilose to puberulent without, glabrous to pilose within; petals orbicular-obovate, 12–17 mm. long, somewhat wider, cerise to crimson, apically rounded; stamens 12–13 and 9–10 mm. long; anthers light, about 3 mm long, style stout, sparsely pubescent to glabrous, extending about to end of sepals, stigma subglobose, 4-lobed, green, about 4 mm wide, fruit elongate, more than 1 cm. long

Characterized by its large leaves, purplish color on stems, veins, hypanthium, etc, almost glabrous condition, wide petals and long cylindrical hypanthium, this species seems near *F platypetala, rivularis*, etc.

KEY TO VARIETIES OF *Fuchsia macrostigma*

A Leaves subglabrous except on veins, hypanthium more or less pilose Provinces Carchi to Pichincha, Ecuador 20a. var *longiflora.*

AA. Leaves minutely puberulent, hypanthium densely close pubescent. Provinces Chimborazo to El Oro, Ecuador 20b. var *typica.*

(20a) **Fuchsia macrostigma** Benth var **longiflora** (Benth) Munz, new comb

F longiflora BENTHAM, Pl Hartw, 177, 1845
F spectabilis HOOK., Bot. Mag, 74 pl. 4375, 1848

Leaves subglabrous except on veins, hypanthium more or less pilose

Type locality, Andes of Quito, Ecuador, toward Nanegal Material seen, ECUADOR Carchi Olivos, 3200–3500 m, *Mexia 7462* (US) Bolívar Simiatug Hacienda Talahua, 2300 m, *Penland and Summers 657* (F, POM), *614* (POM). Pichincha Quitensian Andes, *Couthouy in 1855* (GH), Montis Pichincha, *Jameson in 1856* (GH, NY) I have not seen the type

(20b) **Fuchsia macrostigma** Benth. var **typica** Munz, new name

(Plate 3, fig. 17)

F. macrostigma BENTHAM, Pl Hartw, 129, 1844
F spectabilis HOOK, var *pubens* JOHNSTON, Contr Gray Herb, 75 34, 1925.

Leaves minutely puberulent, hypanthium densely close-pubescent.

Type locality, "In montibus Pacha," southern Ecuador Benth, l c., 113 says for nos. 708–869. "in montibus circa Loxa"; since this species comes between nos. 733 and 734, one would infer that it came from that region I have not seen the type number, but the description fits very well the following plants: ECUADOR: Chimborazo · Huigra · Hacienda de Licay, *J. N. and G Rose 22479*, type no. of pubens (GH, NY, US) Oro. between La Chorita and Portovelo, *Hitchcock 21168* (GH, NY, US).

(21) **Fuchsia ayavacensis** H B K.

(Plate 3, fig. 18)

Fuchsia ayavacensis H B K, Nov Gen et Sp, 6 107, 1823.
F ampliata BENTHAM, Pl Hartw, 178, 1845.
F Hitchcockii JOHNSTON, Contr Gray Herb, 75 · 33, 1925

Branching, sometimes scandent shrub up to 3 m high, younger branches hirtellous-pilose, more or less purplish, terete, 1 5–3 mm thick, leaves ternate or quaternate, rather crowded, membranaceous, elliptic-lanceolate to -oblanceolate, or -ovate, acute to obtuse at base, acute to acuminate at apex, remotely denticulate, principal veins purplish, laterals 6–10 on each side of midrib, the submarginal present, leaf-blades pilose or pubescent and dark green above, paler and pilose beneath especially along veins, 4–9 cm long, 1 5–3 cm wide, petioles pilose, slender, mostly 5–20 mm long, stipules subulate-lanceolate, 1 5–2 mm long, deciduous, flowers in upper axils, pedicels slender, pubescent, 2 5–4 (5) cm long, ovary oblong-fusiform, hairy, 6–7 mm long, hypanthium deep red, 3 5–5 (6) cm long, bulbous at base and 3 5–5 mm wide, then constricted for 1–2 cm and 2–3 mm wide, then quickly widened until 7–11 mm. wide just below the slightly constricted apex, sparsely pilose without, densely so within most of its length, sepals acuminate, subulate for 1–2 mm at apex, somewhat pilose on back, glabrous above, petals scarlet, rounded-obovate, 10–13 (15) mm long, about as wide, stamens 13–17 and 10–14 mm long, anthers 3 mm long, style densely pilose throughout its portion within the hypanthium, sparsely so on base of exposed portion, about equalling the sepals, stigma 2–2 5 mm thick, fruit apparently ellipsoid

Type locality, Ayavaca (Ayabaca), Piura, Peru There is some question as to whether I have seen the original material, number 3115 of Humboldt in the Willdenow Herbarium at Berlin labeled Fuchsia is interpreted by Lewin as *ayavacensis* A photograph was distributed by the Field Museum as *F hirta,* which name has never been published No 3115 in the Bonpland Herbarium at Paris is labeled "*F ayavacensis* HBK, *F ampliata* Benth !" as from Rucu Pichincha It agrees well with the description, as does type material of *F ampliata* In the type of *F Hitchcockii,* the petals are only half the sepals, the hypanthium is rather long, but both these conditions are matched by some of the Jameson collections. The reflexed-spreading sepals and round petals shorter than the sepals, the pilose condition of the largish leaves characterize *F ayavacensis* Representative material ECUADOR · without locality, *Jameson* (US) Pichincha Canton Quito road from Cotocollao, near Nono, 2987 m, *Mexia 7661* (POM, US); Volcán de Pichincha, 3500–4000 m, *Mexia 7654* (POM, US), La Chorera, above Quito, *Balls 7234* (US), Pichincha, *Jameson 73* (NY), sive Andium Quitensium, *Jameson 42* (GH), *30* (NY), Andes of Quito, *Jameson* (US); in declivitate montis Pichincha, 3000 m, *Hartweg 988,* type no *ampliata* at Berlin (photo F, POM), Rucu Pichincha, *Bonpland 3115,* Herb Mus Paris (F), *Humboldt 3115* at Berlin (photo F, POM) Azuay · between Oña and Cuenca, *Hitchcock 21603,* type no Hitchcockii (GH, NY, US)

(22) **Fuchsia Pringsheimii** Urban

(Plate 4, fig. 19)

Fuchsia Pringsheimii Urban, Symb Antill, 1·375, 1898–1900

Shrub 1–2 m tall, openly branched, the ultimate branchlets purplish, 1–2 mm thick, fine-pubescent; leaves opposite, fairly near each other, not much reduced upward, subcoriaceous, strongly bicolored, ovate-elliptic, to rhomboid-elliptic, acute at base, acute to acuminate at apex, somewhat remotely serrulate, in maturity mostly subglabrous except on veins of both surfaces, principal lateral veins 3–4 on each side of midrib, petioles 4–7 mm long, blades 1 5–2 5 cm long, 0 5–1 cm wide, flowers in axils of upper leaves, pedicels subglabrous, 2–5 cm long, hypanthium funnelform, 23–26 mm long, red, glabrous without and within, constricted above ovary, then with tubular portion about 2 mm wide, 10–15 mm long, the upper expanded portion 10–15 mm long, 8–12 mm wide, sepals red, lanceolate, acuminate, glabrous, 18–22 mm long, 7–8 mm wide at base, petals red, equalling or slightly exceeding sepals, obovate, episepalous stamens almost as long as petals, anthers 3 mm long, epipetalous slightly shorter, the anthers 2 5 mm long, style glabrous, equalling petals or up to 5 mm longer, stigma clavate, slightly 4-lobed, 2 mm long, berry ellipsoid, 10–14 mm long, half as thick.

Type locality, "Valle nuevo," Santo Domingo, at 2100 m, the type *Eggers 2159* The species differs from *F triphylla* by having the flowers in axils of reduced leaves not in an inflorescence, leaves more glabrous, and by sepals and petals being longer in relation to the hypanthium It and *F triphylla* and *ayavacensis* seem to be related in their ampliate hypanthium and wide petals I have seen the following specimens of *Pringsheimii* HAITI: Massif de la Pelle, Pétionville, Morne La Visite, at 2100 m, *Ekman H 1450* (US) SANTO DOMINGO prope Constanza in Valle nuevo, 2300 m, *von Tuerckheim 3151* (F, GH, NY, US). A collection from Massif de la Pelle, Marigot, near Jardins Bois-Pin, Haiti, *Ekman H 1260* (US) has leaves of *triphylla* and flowers of *Pringsheimii*

(23) **Fuchsia triphylla** L

(Plate 4, fig 20)

Fuchsia triphylla L, Sp Pl, 1191, 1753

Apparently semishrubby, 3–5 dm tall, stems 1 to few, simple or few-branched, the younger ones reddish, densely pubescent, 2–4 mm thick; leaves ternate or quaternate or opposite, the lower ones remote, middle and upper crowded, coriaceous, lanceolate to lance-ovate, acute to acuminate at both ends, subentire to serrulate, often with inrolled margin, bicolored, often reddish on veins, fine-pubescent on both surfaces, petioles pubescent, 3–10 (20) mm. long, main blades 3–8 (10) cm long, 1–3 (4 5) cm wide; uppermost reduced to leafy lanceolate or lance-ovate bracts; flowers several, pendulous, in dense terminal racemes; pedicels 15–20 (30) mm long, rather slender, pubescent, hypanthium slightly contracted then expanded, funnelform, red, pubescent without, glabrous within, the tubular part 1 5–2 mm wide, 8–16 mm long, the expanded part 4–7 mm wide, 15–20 mm long; sepals red, lanceolate, erect, acuminate, 8–13 mm long, 4–5 mm. wide at base, puberulent; petals red at apex, apparently lighter toward base, ovate-oblong, 8–10 mm long, stamens as long as or two-thirds as long as petals, anthers 2–2 5 mm long; style glabrous, scarcely equal to sepals, stigma conic, not much lobed, 1 5 mm long, berry subglobose, at least 1 cm long.

Type locality, "Habitat in America" according to Linnaeus who refers to Plumier, Gen, 14, 1703, where the genus *Fuchsia* was founded with a rude drawing (cf Pl 16, figs 92–95) Linnaeus basing *F triphylla* on Plumier Lamarck, Encyc 2 565, 1786, said that Plumier had found the species in the Island of Santo Domingo, in uncultivated places, in going from the region "de la Bande du Sud à celui qu'on nomme le grand Cul-de-sac" Linnaeus placed the genus under Tetrandria Monogynia, but in the Gen Pl ed 2, 53, 1764, observed "Plumier in Generibus stamina quator, in Historia vere saepius octo pingit" Presumably then, the species should have been described as having eight stamens and coming from Santo Domingo Of the specimens listed below, there seem to be two forms one with leaves heavy, lanceolate, 1–2 cm wide; the other less thick, 2–4.5 cm wide In the first may be cited HAITI vicinity of Mission, Fonds Varettes, at 1000 m, *Leonard 3681* (NY, US), *3701* (NY, US) Belonging to the second group are HAITI Massif de la Selle, Pétionville, at 1600 m, *Ekman H 1170* (US) SANTO DOMINGO Prov de la Vega, ad ripam fontis Yaque at 1200 m, *Padre Miguel Fuertes 1720* (NY), prope Jarabacoa, 700 m, *Fuertes 1619* (NY), Constanza, *Abbot in 1919* (US), *von Tuerckheim 2956* (F, GH, NY, US), *3541* (NY) Perhaps more material may show that these forms should be separated taxonomically

(24) **Fuchsia petiolaris** H B K

Fuchsia petiolaris H B K, Nov Gen et Sp, 6 104, 1823

Erect bushy shrubs or somewhat scandent, up to 2 m tall, younger twigs reddish, but covered with a fine ashy appressed puberulence, terete, 1–3 mm thick, leaves elliptical to elliptic-ovate, rather dense, membranaceous, touched with purple, obtuse to acute at both ends, remotely serrulate, with 5–7 main veins on each side of midrib and with submarginal vein, minutely puberulent on both surfaces, somewhat paler on lower surface than upper, blades mostly 1 5–5 (8) cm. long, 1–2.5 cm wide, petioles slender, 5–15 mm long, stipules subulate, 1–1.5 mm long, fairly persistent; flowers in uppermost axils, sometimes almost racemose, pedicels minutely strigulose, slender, 1 5–2.5 cm long, ovary strigulose-puberulent, 3–4 mm long; hypanthium red, 3–3.5 mm wide at base, then 2–3 mm. wide for length of 1 cm., then rather abruptly ampliate until 8–11 mm wide just below the slightly constricted summit, 3 5–5 cm long, strigulose-puberulent without, somewhat pilose within lower portion; sepals deltoid-lanceolate, 16–18 mm long, 6–7 mm. wide, acuminate, more or less subulate for terminal 1–2 mm, red, finely strigulose-puberulent on backs, glabrous on upper surface, petals deep red, lance-oblong, 15–17 mm long, 4–5 (8) mm wide, acute, frequently strigulose-puberulent on backs, stamens 12 and 8 mm. long, anthers 2 5–3 mm long, style sparsely pilose in lower portion, equalling sepals; stigma 2 mm wide, berry almost globose when pressed, 8–10 mm. long

This and the species that follow differ from the three previous ones by their narrower petals, and resemble them in the long, more or less ampliate hypanthium and the axillary or subterminal flowers

KEY TO VARIETIES OF *Fuchsia petiolaris*

A Leaf-blades 2–3 times as long as wide, petals 4–5 mm. wide .24a var. *typica*.
AA Leaf blades 4–5 times as long as wide, petals 7–8 mm wide 24b var. *bolivarensis*.

(24a) **Fuchsia petiolaris** H B K var **typica** Munz, new name

(Plate 4, fig 21)

F petiolaris H B K, Nov Gen. et Sp, 6 104, 1823
F quinduensis H B K, l.c, 105, I have seen a portion of the type collection
F curviflora BENTH, Pl. Hartweg, 177, 1845, type from near Bogotá, and not seen by me. Mutis 1366 compared with type by Johnston seems to agree thoroughly and was seen

Leaf-blades, 1.5–5 cm long, one half to one third as wide, petals 4–5 mm wide

Type locality, Santa Fé de Bogotá, Cundimarca, Colombia Representative material, all from COLOMBIA without locality, *Mutis 1365* (US), *1366* (US), *1360* (US) Cundimarca Bogotá, *Dawe 93* (US), *Ariste-Joseph 56* (US), Páramo de Cruz Verde, near Bogotá, *Pennell 2056* (NY), Santa Fé de Bogotá, *Humboldt*, Humboldt Herb at Berlin (photo F, POM) and leaf from Bonpland Herb at Paris (F); Río San Cristóbal, near Bogotá, *Pennell 2379* (GH, NY, US). Caldas sw of Ruiz, Termales, 3400 m, *Cuatrecasas 9218-A* (US); Quindio La Linea, *Dryander 1939* (US) Caldas or Tolima? Quindiu, *Humboldt*, Willdenow Herb. at Berlin, type no *quinduensis* (photo F, POM), fragment from Bonpland Herb at Paris (F) Tolima Volcancito, *Holton 896* (GH, NY), *Ibagué*, at 1300 m, *André K 817* (F, GH,NY), Rosalíto near Páramo de Ruiz, *Pennell 3131* (F, GH, NY, US), along divide near Quindio Highway, 3300–3500 m *Killip and Varela 34600* (POM, US) Comisaría del Putumayo Corregimiento El Encano, Laguna de la "Cocha," *García Barriga 7836* (US), Páramo El Tabano, 3300 m, *García Barriga 7843* (US); Páramo de Faliano, *García B no 4560* (US)

(24b) **Fuchsia petiolaris** H B K var **bolivarensis** Munz, new var.

(Plate 4, fig. 22)

Leaf-blades lanceolate, 5–7 5 cm. long, 12–14 mm. wide, petals obovate, 7–8 mm. wide (Folia lanceolata, 5–7 5 cm. longa, 1.2–1 4 cm lata; petalis obovatis, 7–8 mm. latis)

Type: Colombia · Bolivar: below Páramo de Chaquiro, Cordilerra Occidental, 2800–3100 m., II-24-1918, *F. W. Pennell 4324* (NY) Like var *typica* in puberulence, flower-size, etc

(25) **Fuchsia Smithii** Munz, new species

(Plate 4, fig. 23)

Low shrub to woody vine up to 2–3 m. tall, with drooping branches, the ultimate ones reddish to purplish, more or less ferruginous-villous, terete, 1.5–2.5 mm. thick, older ones with exfoliating epidermis; leaves mostly ternate, sometimes opposite, elliptic to elliptic-ovate or -obovate, obtuse to acute at both ends, or abruptly acuminate at apex, plainly remote-serrulate, pubescent and green above or glabrescent except on veins, paler beneath and generally pilose or only so along the veins, membranaceous, with 9–11 principal veins on each side of midrib and with submarginal vein, leaf-blades 2.5–8 cm. long, 1–2.5 (3.5) cm. wide, petioles slender, villous-pubescent, 5–12 mm. long, stipules subulate-lanceolate, 1–1.5 mm. long, deciduous, flowers in upper axils; pedicels rather slender, pubescent, 2.5–4 (6) cm. long, ovary oblong, pubescent, 6–7 mm. long, 1.5–2 mm. thick, hypanthium tubular, pinkish red to purplish red, 4–5.5 cm. long, 3–4 mm. wide at base, then narrowed to 2–3 mm. for 1.5–2 cm., then rather abruptly widened to 7–9 mm. until near the sometimes slightly constricted apex, loosely pubescent to almost glabrous without, pilose within most of its length, sepals divergent, lanceolate, light to deep red, acuminate with subulate tips ca. 1 mm. long, subglabrous to somewhat pilose on both surfaces, 13–16 (20) mm. long, 5–6 mm. wide, petals dark red to lighter, narrowly oblong-ovate, 13–18 mm. long, 5–6 (8) mm. wide, acute, often erose-margined, usually pilose on back along median line, stamens 11–13 and 9–10 mm. long, red, anthers cream, 2–3 mm. long, style pilose on lower portion, equaling petals, stigma 2.5 mm. thick, berry dark, broadly ellipsoid, 12–15 mm. long, 8–10 mm. wide.

Frutex erectus vel scandens, ad 2–3 m., ramulis ferrugineo villosis, 1.5–2.5 mm. diametro, foliis ternatis vel oppositis, ellipticis, elliptico-ovatis vel obovatis, obtusis vel acutis vel abrupte acuminatis, in superficie superiore pubescentibus, inferiore pilosis, membranaceis, laminis 2.5–8 cm. longis, 1–2.5 (3.5) cm. latis; petiolis tenuibus, villoso pubescentibus, 5–12 mm. longis, floribus axillarbus, pedicellis pubescentibus, 2.5–4 (6) cm. longis, ovario oblongo, pubescente, 6–7 mm. longo, hypanthio tubuloso, 4–5.5 cm. longo, basi 3–4 mm. lato, supra 2–3 mm. lato, versus apicem 7–9 mm. lato, exteriore pubescente ad glabro, interiore piloso; sepalis divergentibus, lanceolatis, acuminatis, 13–16 (20) mm. longis, 5–6 mm. latis, subglabris vel pilosis, petalis oblongo ovatis, 13–18 mm. longis, 5–6 (8) mm. latis, acutis, pilosis, staminibus 11–13 et 9–10 mm. longis, antheris 2–3 mm. longis, stylo piloso, petalis aequalibus, stigmate 2.5 mm. lato, bacca late ellipsoidea, 12–15 mm. longa, 8–10 mm. lata.

Type: **Dept. Santander: vicinity of Vetas, Colombia at 3100–3250 m., open rocky hillsides,** Jan., 1927, *E. P. Killip and Albert C. Smith 17300*, at Gray Herbarium, isotypes (F, NY, US). The proposed species is near *F. petiolaris* of the western Cordillera of Colombia in having pubescence on the back of the petals and in many features, but differs in the coarser longer pubescence, larger leaves, longer pedicels, larger fruit and eastern range. Other material representative, COLOMBIA. Santander del Norte. west slope of Páramo del Hatico, Toledo to Pamplona, 2800 m, *Killip and Smith 20714* (GH, NY, US), between Mutiscua and Pamplona, 3400 m., *Killip and Smith 19734* (GH, NY, US); east slope of Páramo de Santurbán, toward Mutiscua, 3600–3900 m, *Killip and Smith 19599* (GH, NY, US); Pica-Pica Valley above Tapatá north of Toledo, *Killip and Smith 21121* (GH, NY) Santander · Páramo de Romeral, 3800–4100 m, *Killip and Smith 18577* (GH, NY, US); Páramo de las Puentes, above La Baja, 3500–3700 m, *Killip and Smith 18211* (GH, NY, US); Páramo Rico, *Killip ànd Smith 17771* (GH, NY, US), *17755* (F, GH, NY, US); vicinity of Vetas, *Killip and Smith 17361* (GH, NY, US), *17335* (GH, US), *17386* (GH, US), edge of Páramo de Las Vegas, *Killip and Smith 15734* (F, GH, NY, US), *15610* (GH), between California and Vetas, *Killip and Smith 17236* (GH, NY, US) Boyacá · between Soatá and Cocuy, Páramo del Alto Cañutal, *Cuatrecasas 1183* (US), Valle de la Uvita, *Cuatrecasas 1146* (US), *1161* (US).

(26) **Fuchsia Asplundii** Macbride

(Plate 4, fig 24)

Fuchsia Asplundii MACBRIDE, Field Mus. Nat Hist, Bot Ser, 13, pt 4, no 1 548, 1941

Shrub, young twigs apparently dark in color, densely crisp-pubescent, 1–2 mm. thick, leaves ternate or quaternate, membranaceous, broadly elliptic-lanceolate, acute to obtuse at base, acute to subacuminate at apex, subentire, strigose above, more or less pilose beneath especially along veins, principal lateral veins 8–12 on each side of midrib, the submarginal vein well developed, blades 3–8 cm long, 1–2 5 cm wide, petioles appressed-pubescent, 1–1 5 cm long on main cauline leaves, 4–5 mm on reduced upper leaves, stipules lance-subulate, 1 mm long, strigose, deciduous, flowers solitary in axils of some of principal leaves, or appearing subterminal, pedicels slender, crisp-pubescent, 1–2 5 cm long, ovary linear-fusiform, crisp-pubescent, 6–8 mm long, hypanthium 4–5 cm. long, 2 mm thick at base, then somewhat narrowed for one-third its length, then gradually ampliate until 5 mm wide at mouth, crisp pubescent without, pilose within lower half; sepals divergent, 12–14 mm long, 3 mm wide, subulate for about 1 mm at apex, crisp-pubescent on backs, glabrous on upper surface, petals oblong-ovate, 10–12 mm long, 5–6 mm. wide, obtusish, glabrous, stamens 10–11 and 7–8 mm long, anthers 3 mm long, style pilose on basal half, exserted beyond sepals 4–6 mm, stigma about 1 mm thick; fruit narrow-ellipsoid, 4-angled, at least 12 mm long, and 8 mm. wide

Type from PERU Dept Piura Prov Huancabamba above Palambla, at 3000 m., April, 1912, *Weberbauer 6054* (F, GH, US) This species suggests *F ayavacensis* in the almost terminal flowers, but the hypanthium is narrower, as are the petals. In its narrow petals and pubescent stems it resembles *F. petiolaris* and *F. Smithii*, but the pubescence is crisped, the fruit is more narrow and the range more southern

(27) **Fuchsia Llewelynii** Macbride

(Plate 5, fig. 25)

Fuchsia Llewelynii Macbride, Field Mus. Nat. Hist., Bot. Ser., 13, part 4, no. 1: 556, 1941

Shrub 1 m. tall, young twigs finely and closely appressed-puberulent, leaves opposite, rigid, broadly oblong-oblanceolate to -lanceolate, acute at both ends, plainly serrulate, minutely appressed-puberulent above and beneath especially on veins, apparently paler beneath, with about 11–14 principal lateral veins on each side of midrib and with submarginal vein, blades 4–9 cm. long, 1.5–3 cm. wide, petioles 4–8 mm. long, stipules subulate, 2 mm. long, fairly persistent, flowers apparently racemose, pedicels subfiliform, strigulose, 3–5 cm. long, ovary fusiform, strigulose, 5–6 mm. long, hypanthium about 5 cm. long, 2 mm. wide at base, then about 1 mm. wide for 1.5 cm., then rather gradually ampliate until 5 mm. wide at summit, strigulose without, pilose within the lower half, sepals linear-lanceolate, divergent, 14–17 mm. long, 4 mm. wide at base, subulate for 1–2 mm. at apex, strigulose without, glabrous within, petals oblong-lanceolate, 15–16 mm. long, 4–5 mm. wide, acuminate, stamens 12–13 and 10–11 mm. long, anthers 2–2.5 mm. long; style densely pilose on basal portion, exceeding sepals by few mm., stigma 1.5 mm. thick.

Type from PERU: Dept. Amazonas: La Ventana Road, Chachapoyas to Moyobamba, *Llewelyn Williams 7594* (F). The type specimen is much broken and rather unsatisfactory; apparently from a plant with long slender racemes. It is near *F. petiolaris* in the puberulence and long pedicels, but the leaves seem larger and with more veins, and the hypanthium is more narrow. It is near *F. Asplundii* in the narrow hypanthium but has much finer puberulence.

(28) **Fuchsia venusta** H.B.K.

Fuchsia venusta H.B.K., Nov. Gen. et Sp., 6.105, 1823

Shrub or shrubby vine, the young twigs hirtellous to puberulent or subglabrous, often dark red, 2–6 mm. thick; leaves opposite or ternate, elliptic, rounded to acute at base, acute to acuminate at apex, subentire, subcoriaceous, not much paler beneath that above, subglabrous to puberulent or pubescent on both sides, especially on veins, principal lateral veins mostly 10–15 on each side of midrib, with evident submarginal vein, blades 4.5–8 (10.5) cm. long, 2–3.5 (4) cm. wide, petioles 6–10 mm. long, puberulent to pubescent; stipules triangular-subulate, barely 1 mm. long, deciduous, flowers in a terminal pendant corymbose raceme or in panicles scarcely 1 dm. long; bracts elliptic-lanceolate, 1–2 cm. long; pedicels 1–3 cm. long, almost filiform, glabrous to pubescent, ovary oblong, 6–7 mm. long, ca. 2 mm. thick; hypanthium tubular, red, subglabrous to glandular-pubescent without, villous within lower portion, 3–4 cm. long, 2.5–3 mm. wide at base, then about 2 mm. wide for one-third its length and gradually widened until 6–7 mm. broad at summit; sepals lanceolate, acuminate, the connivent tips subulate for 3–4 mm., sepals red, glabrous to pubescent on backs, pubescent within, more or less spreading, 15–17 (20) mm long, 3–4 mm wide, petals carmine, oblong-lanceolate, abruptly acute, more or less pubescent on backs, 15–18 (20) mm long, stamens 12–13 (15) and 9–10 (12) mm long, glabrous; anthers 2 5–3 mm long, style slender, densely villous through much of its length, extending to about tips of sepals, fruit oblong, up to 14 mm long and 7 mm wide

This species is characterized by its short elliptic coriaceous leaves, terminal inflorescence, short petioles, long pedicels, sepals hairy on inner surface as well as outer, petals hairy on backs In the more or less ampliate hypanthium and subterminal flowers it agrees with those immediately preceding and following in this treatment There are two forms as to pubescence which I am recognizing as varieties

KEY TO VARIETIES OF *Fuchsia venusta*

A Young twigs, petioles, hypanthia pubescent with short spreading hairs 28a var *typica*

AA Young twigs, petioles, hypanthia glabrous to minutely puberulent with more or less appressed hairs 28b var *huilensis*

(28a) **Fuchsia venusta** H B K var **typica** Munz, new variety

(Plate 5, fig 26)

F venusta H B K., Nov Gen et Sp, 6 105, 1823

Hairs on young growth and flowers spreading

Type locality near **Guayavalito, Colombia.** Ranging in the eastern Cordillera of Colombia in Santander and Cundimarca Representative material, COLOMBIA Guayavalito (exact locality not determined), *Humboldt*, ex Willdenow Herb 7301 (photo F, POM), Bonpland Herb ex Mus Paris (fragment F) Without locality, *Mutis 1370, 1362, 1367*, and *1369* (all at US), eastern Cordillera, *Bro Ariste-Joseph A893* (US) Santander Chiquinquirá, *Ariste-Joseph A 842* (US) Cundimarca Tena, *Dawe 23* (US); Bogotá, *Schultze 69* (US), *Ariste-Joseph A229* (US); Salto de Tequendama, 2500 m, *Cuatrecasas 48* (US), Cordillère de Bogotá, 1800–2600, *Triana 3814* (NY, US), ad cataractam Tequedamam, *Holton 894* (GH, NY), Páramo de San Fortunato et prope pagum Fusagasuga, *Hartweg 995* (NY)

(28b) **Fuchsia venusta** H B K var **huilensis** Munz, new variety

Young growth, hypanthia, etc, glabrous to minutely appressed puberulent (Ramula, petiola, et hypanthia glabra vel minute striguloso-puberulenta)

Type: from **Huila, Colombia: Cordillera Oriental, east of Neiva, forest at 1800–2300 m.,** *Rusby and Pennell 874*, (NY); isotypes (F, GH, US) Material to be referred here comes from two widely separate regions, VENEZUELA: Mérida: Páramo de Aricagua, 2700 m, *Jahn 1029* (GH, US) Táchira: Páramo de Angaraveca, 2400 m, *Jahn 129* (US) COLOMBIA Cundimarca: Dintel (Facatativá-La Vega) 2700–2300 m, *Pérez A and Cuatrecasas 5291* (US); Une, in montibus ad orient. Bogotae, *Holton 895* (NY). Tolima. Libano, 1900–2200 m, *Pennell 3197* (GH, NY, US). Huila

Cordillera Oriental, east of Neiva, *Rusby and Pennell 641* (GH, NY, US), "Balsillas" on Río Balsillas, 2000–2300 m, *Rusby and Pennell 918* (NY), *722* (GH, NY, US), *809* (NY, US).

(29) **Fuchsia Jahnii** Munz, new species

(Plate 5, fig 27)

Apparently a scandent shrub with younger twigs very slender, 1–2 mm thick, drooping, somewhat purplish, puberulent with appressed hair, leaves opposite or ternate, elliptic, rounded to acute at base, short-acuminate at apex, remotely denticulate, minutely pubescent on both surfaces, darker green above than beneath, membranaceous, with about 10–12 principal veins on each side of the midrib and with submarginal vein, blades 3–8 cm long, 1–3 cm wide; petioles 6–15 mm long, more or less strigulose, stipules lance-subulate, ca 2 mm long, deciduous, flowers few in terminal corymbose raceme, sometimes also axillary; bracts 1–2 (3) cm long, pedicels filiform, strigulose, 2–4 cm. long; ovary broadly fusiform, strigose, 5–6 mm long; hypanthium red, tubular, 3 5–4 cm long, strigulose without, villous within, 2 5–3 mm wide at base, then 1 5–2 mm. thick and very gradually widened until 7–8 mm wide toward the mouth; sepals red, lanceolate, spreading, 18–20 mm long, 3 5–4 mm wide, acuminate (the connivent tips subulate for 3–4 mm in bud), strigulose without, glabrous within, petals light red, oblong-oblanceolate, 18–20 mm long, abruptly acute, somewhat strigulose on back toward base, stamens 16–18 and 12–14 mm. long, glabrous, anthers 2 5–3 mm long, style slender, retrorse-villous, projecting about as far as petals, stigma subglobose, slightly lobed, 2 mm wide, berry almost globose, strigulose, about 12 mm long, 10–11 mm wide

Frutex scandens, ramulis subpurpureis, strigulosis, foliis oppositis vel ternatis, ellipticis, basi rotundatis vel acutis, apice breviter acuminatis, remote denticulatis, minute pubescentibus, membranaceis, laminis 3–8 cm longis, 1–3 cm. latis; petiolis 6–15 mm longis, substrigulosis, floribus paucis, subracemosis, bracteis 1–2 (3) cm. longis, pedicellis filiformibus, strigulosis, 2–4 cm. longis; ovario late fusiformi, strigoso, 5–6 mm longo; hypanthio rubro, tubuloso, 3 5–4 cm. longo, externe striguloso, interne villoso, base 2.5–3 mm. lato, inde 1 5–2 mm. lato, inde gradatim ampliato, usque ad apicem 7–8 mm. lato, sepalis rubris, lanceolatis, divergentibus, 18–20 mm longis, 3.5–4 mm. latis, acuminatis, strigulosis, cum apicibus subulatis 3–4 mm. longis; petalis roseis, oblongo oblanceolatis, 18–20 mm. longis, abrupte acutis, basi et extrinsecus substrigulosis, staminibus 16–18 et 12–14 mm longis; antheris 2.5–3 mm longis; stylo tenui, retrorsovilloso, petalis aequalibus aequescente, stigmate subgloboso, 2 mm lato, bacca subglobosa, strigulosa, 11–12 mm longa

Type: **Mérida, Venezuela, Páramo de la Sal, 2800 m.**, Sept 2, 1921, *Jahn 506* U S. Nat. Herb. 1186509; isotype Gray Herb. Another collection, Mérida · Páramo de Piñango, 2600 m, *Jahn 402* (US) Apparently closely related to *F. venusta* and characterized by a few flowers, strigulose condition, spreading sepals with long subulate tips, hair on back of petals, and big round fruit.

(30) **Fuchsia Gehrigeri** Munz, new species

(Plate 5, fig. 28)

Subscandent shrub 3–5 m tall, with slender, ultimate, reddish, drooping branchlets 1–2 mm. thick, subglabrous or somewhat villous about the nodes and toward the inflorescence, somewhat reddish; leaves opposite or ternate, *membranaceous*, elliptic, acute to subacuminate at both ends, serrulate, green and minutely strigulose above, pale beneath and pubescent along the veins, principal lateral veins 7–10 on each side of midrib, submarginal vein scarcely evident, blades 3–6 cm long, 1 5–2 5 (3) cm wide, petioles slender, 10–18 mm long, subglabrous to pubescent; stipules subulate, 1 mm long, deciduous; flowers *few, in terminal clusters of about 2 whorls, pendant*, dark red, bracts 1–1 5 cm long, pedicels slender, 1 5–2 cm long, more or less spreading-villous, ovary broadly fusiform, 5 mm long, densely spreading-villous, hypanthium tubular, 4–5 cm long, 2 mm wide at base, then narrower for one-third its length, and rather abruptly widened until 7–8 mm wide at summit, villous without and within, sepals lanceolate, divergent, 14–15 mm long, 4 mm wide, acuminate (subulate tips connivent and 1 mm long in bud), pubescent on back, glabrous on inner surface, petals dark red, elliptic-oblong, obtuse-erose, ca 14 mm long and 6 mm wide, sparsely villous on back near the base, stamens 9–10 and 7–8 mm long, anthers 2 mm long, style pubescent on lower portion, exceeding sepals by 3–5 mm, quite thick toward the somewhat lobed stigma (1 5–2 mm wide), fruit subglobose, somewhat villous

Frutex subscandens, 3–5 m altus, ramulis tenuibus, subrubris, 1–2 mm. diametro, sub glabris vel subvillosis in nodis et ad inflorescentiam, foliis oppositis vel ternatis, membranaceis, ellipticis, basi et apice acutis vel subacuminatis, serrulatis, in superficie superiore viridibus et minute strigulosis, inferiore pallidis et in venis pubescentibus, laminis 3–6 cm longis, 1.5–2 5 (3) cm latis, petiolis tenuibus, 10–18 mm longis, subglabris vel pubescentibus, floribus paucis, in inflorescentia terminali, subrubris, bracteis 1–1.5 cm longis, pedicellis tenuibus, 1 5–2 cm. longis, subvillosis, *ovario late fusiformi*, 5 mm longo, villoso, hypanthio tubuloso, 4–5 cm longo, basi 2 mm. lato, inde angustiore, inde abrupte ampliato, ad apicem 7–8 mm. lato, *externe et interne villoso*, *sepalis lanceolatis, divergentibus*, 14–15 mm. longis, 4 mm latis, acuminatis, externe pubescentibus, apicibus subulatis 1 mm longis, *petalis elliptico-oblongis, obtuso-erosis, 14 mm. longis, 6 mm latis, sparse externe* villosis, staminibus 9–10 et 7–8 mm. longis, antheris 2 mm longis, stylo pubescenti, quam sepala 3–5 *mm. longiore, stigmate* 1 5–2 *mm.* lato, *fructu subgloboso*, subvilloso

Type: from **Mérida: Mucurubá, Venezuela, 2800–3100 m.**, July 14, 1930, *W Gehriger 322*, U. S Nat. Herb 1515306, isotypes F, GH, NY. This species is near *F. Jahnii* in its leaves, few flowers, round fruit, and petals with hair on the back, but the pubescence is longer and more spreading, the pedicels are shorter; sepal-tips shorter, flowers smaller, and sepals are less spreading

(31) **Fuchsia simplicicaulis** Ruiz and Pavón

(Plate 5, fig 29)

Fuchsia simplicicaulis Ruiz *and* Pavón, Fl Peruv, 3:89, pl 322, 1802.

Shrub, apparently growing up through other shrubs, up to 4 5 m tall; stems slender, the ultimate branchlets pendant, scarcely 1 mm thick, glabrous except for the puberulent inflorescence; leaves in remote whorls of 4, linear-lanceolate, coriaceous, glabrous, subentire, obtuse to acute at base, acuminate at apex, not strongly bicolored, with 20 or more principal lateral veins on each side of midrib, and with submarginal vein, 8–15 cm long, 1.5–2 (2.5) cm wide, petioles 2–4 mm long; stipules subulate, ca 1 mm. long, deciduous, inflorescence a simple or few-branched hanging puberulent raceme 2–3 dm. long, with remote whorls of 4 submembranaceous lance-ovate, acuminate, green bracts 2–4.5 cm long and 6–14 mm wide, flowers one in each axil, bright red with slightly purplish tinge, pedicels 4–7 mm long, 12 mm in fruit; ovary puberulent, ellipsoid, 5–6 mm. long, 1.5–2 mm thick, hypanthium tubular, 4–5.5 cm long, puberulent without and within, ca 3 mm. wide at very base, then 1.5 mm for two-fifths its length, then rather gradually ampliate and tubular, 5–6 mm wide at summit, sepals 4, linear-lanceolate, puberulent, acuminate, 16–18 mm long, 4 mm wide, somewhat divergent, petals red, linear-lanceolate, acute, 11–12 mm long, 2–2.5 mm wide, stamens ca 14 and 10 mm long; anthers 3 mm long, style pubescent in lower hypanthium, slightly exceeding petals, fruit oblong, puberulent, at least 8 mm long

Type locality, Muña, Peru Specimen seen, PERU Húanuco Muña, at 2200 m, May 23–June 4, 1923, *J F Macbride 4014* (F, GH, US), photo of Ruiz and Pavón specimen from Muña at Madrid (F, POM) This species stands apart from all others in its almost linear leaves and bracts in whorls of 4, in its long pendant twigs, and in its puberulence It agrees with *F petiolaris* and *F venusta* in its subterminal inflorescence, slightly inflated hypanthium and narrow petals

(32) **Fuchsia confertifolia** Fielding and Gardner

(Plate 6, fig 30)

Fuchsia confertifolia Fielding and Gardner, Sert. Pl, pl 28, 1844

F. dolichantha Krause, Fedde, Rep, 1 172, 1905, based on Weberbauer 4390 from the Chachapoyas region in which Mathews collected, *confertifolia* being based on a Mathews type.

Erect shrub up to 2 m tall, much branched, the young twigs 1.5–3 mm thick, densely ferrugineous-hirsute, leaves opposite to ternate or quaternate, crowded, spreading-reflexed, oblong-ovate, rounded to acute at base, acute at apex, entire to subdenticulate, glabrous on both surfaces or sparsely hairy beneath on veins, principal lateral veins obscure, 3–4 on each side of midrib, blades 12–16 mm long, 3–4 (6) mm wide; petioles 1–2 mm long, stipules dark, glabrous, subulate, 1–1.5 mm long, persistent, flowers very few, subterminal, pendant, bracts about 5 mm long, 1.5 mm wide, pedicels 1–1.5 cm long, up to 2 cm in fruit, villous; ovary oblong, 4–5 mm long, hypanthium dark red, tubular, 4–5 cm long, slightly enlarged at very base and 1.5–2 mm wide, then narrowed for one-third its length, then abruptly widened and subcylindric until 6–8 mm wide at and below the summit, sparsely villous without, more densely so within; sepals linear-lanceolate, divergent, 16–18 mm long, acuminate, scarcely subulate at tips, sparsely villous without, glabrous within, petals red, elliptic-lanceolate, acuminate, glabrous, 12–13 mm. long, 3 mm wide, stamens about 13 and 9 mm long, anthers 2 5 mm. long, style pilose near base, equal to sepals; stigma capitate, slightly lobed, 2 mm wide; fruit ellipsoid, ca 1 cm. long.

Type locality, "Peru." Specimens seen, PERU Dept Amazonas · between Jumbilla and San Carlos, 3000 m, *Weberbauer 7153* (F, GH), ab Chachapoyas at orientem versus Tambo Ventillas, *Weberbauer 4390,* type *dolichantha* at Berlin (photo F, POM)

(33) **Fuchsia Aspiazui** Macbride

(Plate 6, fig 31)

Fuchsia Aspiazui MACBRIDE, Field Mus Nat Hist, Bot Ser, 19, part 4, no 1 547, 1941

Shrub up to 2 m tall, the younger branches 4–6 mm thick, minutely strigulose under a lens, greenish, terete, leaves opposite, elliptic-ovate to -obovate, subentire, apparently rather fleshy, glabrous on casual inspection, but minutely strigulose under a lens, cuneate at base, rather abruptly acuminate at apex, yellowish green and much alike on both surfaces, conspicuously veined, the main laterals 18–24 on each side of the midrib, with evident submarginal vein, blades 8–20 cm long, 4–10 cm wide, petioles 1–2 (3 5) cm long, stipules lance-deltoid, 2–3 mm long, sometimes fused in pairs, deciduous, inflorescence a terminal strigulose pendant raceme with rather numerous flowers; bracts reflexed, lanceolate, 1–2 cm long; pedicels 8–12 mm long, ovary linear, 5–8 mm long, 1 mm, thick, glabrous to somewhat strigulose; hypanthium blood-red, tubular, 3–5 cm long, slightly bulbous at base, then about 1 mm wide and very gradually ampliate toward the summit where it is 4–5 mm wide, practically glabrous without, retrorse-pubescent within basal part, sepals divergent, red, lanceolate, 12–15 mm long, 3–4 mm wide, acute, without free tips in bud, petals oblong, obtuse, about 1 cm long, 3 5 mm wide, stamens about 8 and 6 mm long; anthers barely 2 mm long, style quite glabrous, extending about to the end of the petals, immature berry linear-oblong, 12 mm long, 3 5 mm wide

Based on a collection from valley of the Río Mixiollo, Prov Pataz, Dept Libertad, PERU, 2300–2500 m, *Weberbauer 7042* (F, GH, US) Characterized by its glabrous condition, large leaves with many veins, short pedicels, and glabrous style, it comes in the group of species with large leaves, short terminal inflorescence, and narrow long hypanthium

(34) **Fuchsia tincta** Johnston

(Plate 6, fig 32)

Fuchsia tincta JOHNSTON, Journ. Arn Arb, 20.242, 1939

Shrub, 1–1 5 m. tall, the young twigs more or less brownish red, 1–5 mm. thick, puberulent or finely pubescent with somewhat brownish hairs, leaves opposite, membranaceous, elliptic-ovate to -obovate, rounded to obtuse at base, acute to subacuminate at apex, remotely serrulate, more or less purplish especially beneath, finely pubescent on both sides, even somewhat short-pilose on veins beneath, the principal lateral veins 16–18 on each side of midrib, the submarginal vein present, blades 5–12 (15) cm long, 3–8 (10) cm wide, petioles 1–4 (6) cm long, stipules subulate, 1 mm long, deciduous, flowers few to several in open terminal finely pubescent corymbose racemes; bracts rather leafy, 1 5–3 cm long, pedicels slender, pubescent, 1 5–3 cm. long; ovary linear-fusiform, pubescent, 4–5 mm long; hypanthium 20–25 (35) mm long, deep crimson, 1 5–2 mm wide at base, then narrowed for one-third its length, then gradually widened to 3–4 mm. at summit, rather sparsely villous without, villous within lower two-thirds; sepals crimson, divergent, 8–10 mm long, 3 5 mm wide at base, subulate for 0 5–1 mm at apex, villous on backs, petals crimson-scarlet, oblong-ovate, 7–8 mm long, 4–5 mm wide, erose-rounded to obtusely mucronate at apex, stamens about 8 and 6 mm. long, anthers 1 5 mm long, style pilose in basal portion, equaling sepals, stigma 1–1 5 mm. wide; berry ellipsoid-oblong, 8–12 mm long, 4 5–6 mm wide.

Type locality, PERU dept Cuzco, prov Paucartambo Río Tambomayo at 1800–2200 m, the type collection being *West 7092* (GH), another collection from the same locality *West 7110* (GH) I have seen also from Cabecera de montaña de Paucartambo, at 2000 m, *Vargas 73/7110* (F, POM) and "Pillahuata," Cerro de Cusilluyoc, 2000–2400 m, *Pennell 13956* in large part (F, NY, US) The species is near *F ovalis* in its wide leaves, but the racemes are terminal, the pubescence shorter, the stipules shorter and the hypanthium longer When the hair is not too brown, it suggests *F boliviana,* but the sepals are not reflexed-spreading In its long-tubed flowers it resembles *F furfuracea,* but the sepals are shorter and the plant is less pilose

(35) **Fuchsia Mathewsii** Macbride

Fuchsia Mathewsii Macbride, Candollea, 8·24, 1940, Field Mus. Nat. Hist, Bot. Ser, 13, pt 4, no 1·558, 1941.

Branches and petioles and lower leaf-surface densely rusty-pilose, leaves ternate, broadly elliptic, abruptly narrowed at base, acute at apex, obscurely denticulate to subentire, minutely pilose above, densely so beneath along midrib; blades 1 dm long, petioles 4–5 mm long; inflorescence a terminal short-bracted panicle about 5 cm long; hypanthium 4 cm long, glabrate without, hirsutulose within lower half, sepals 10 mm long, petals oblong-obovate, almost as long as sepals.

Based on a collection by Mathews, from Chachapoyas, Amazonas, Peru Said to be near *F. pilosa,* but differing in its short-petioled leaves, denser shorter rusty pubescence and its larger flowers. I have seen no specimens. The meager description suggests *F tincta* of a more southern distribution and with apparently longer petioles and shorter hypanthium.

(36) **Fuchsia Fischeri** Macbride

Fuchsia Fischeri MACBRIDE, Field Mus. Nat. Hist., Bot Ser, 13, part 4, no. 1. 554, 1941.

Shrub, suberect, branched, the young twigs reddish, densely hirsutulous; leaves opposite, oblong-lanceolate, subcuneate at base, acute at apex, subentire to obscurely callose-denticulate, densely soft-pilose on both sides, veins prominent beneath, petioles 2–5 mm long, stipules subulate, somewhat persistent, inflorescence a terminal leafy-bracted corymb 5–6 cm long, pedicels 1.5 cm long, ovary velutinous, 4 mm long, hypanthium about 4.5 cm long, swollen at base, then constricted, then ampliate until 4–5 mm wide at apex, somewhat villous without and within, sepals lanceolate, acuminate, 10–12 mm long; petals narrowly oblong-lanceolate, short-acuminate, about 9 mm long, stamens shorter than petals, style pubescent in lower portion, more or less exserted

Type not seen, based on *Weberbauer 4097* from Hualgayoc, Chugar, Cajamarca, Peru. No specimens available and description meager, but this seems to be a distinct entity near *F Mathewsii*, perhaps with more narrow leaves

(37) **Fuchsia Storkii** Munz, new species

(Plate 6, fig 38)

Tree, or shrub up to 3 m tall, twigs reddish, pubescent or pilose with reddish hairs, leaves ternate, narrowly elliptic to elliptic-oblanceolate, firm, obtuse to acute at base, acute at apex, remotely serrulate, light green above, pilose to subglabrous or pubescent on veins above, slightly paler and more pilose beneath, principal lateral veins 8–9 on each side of midrib, submarginal veins present, leaf-blades 2–7 cm long, 1.3–2 cm wide; petioles reddish-pilose, 4–8 mm long, stipules lance-subulate, 1.5–2 mm long, glabrous, fairly persistent, flowers few, in short terminal drooping glandular-pubescent corymbose racemes, bracts lanceolate, pedicels stout, red-pubescent, 2–5 mm long, ovary ellipsoid, glandular-pubescent to red-pilose, 4–5 mm long, hypanthium dark red, about 3 cm long, somewhat bulbous and 1.5–2 mm wide at base, then somewhat narrowed and then gradually ampliate until 5 mm wide at apex, glandular-villous without, villous within lower half, sepals deep red, lanceolate, about 12 mm long, 4 mm wide, subulate for 1.5–2 mm at apex, glandular-pubescent, petals deep red, oblong-lanceolate, 7–9 mm long, 3 mm wide, sharply acute; stamens about 8 and 6 mm long, anthers 2 mm. long; style pubescent in lower portion, extending about to sepal-tips; fruit apparently ellipsoid, at least 1 cm long

Arbor vel frutex; ramulis rubescentibus, pubescentibus vel pilosis, cum pubescentia rubida, foliis ternatis, anguste ellipticis vel elliptico-oblanceolatis, base obtusis vel acutis, apice acutis, remote serrulatis, in venis superficiei superioris pilosis vel pubescentibus vel subglabris, inferiore pilosioribus; laminis 2–7 cm longis, 1.3–2 cm. latis; petiolis rubido pilosis, 4–8 mm. longis; stipulis lanceolato subulatis, 1.5–2 mm. longis, glabris, subpersistentibus; floribus paucis in racemis brevibus, terminalibus, glanduloso pubescentibus; bracteis lanceolatis, pedicellis rubido pubescentibus, 2–5 mm. longis; ovario ellipsoideo,

4–5 mm. longo, hypanthio rubido, 3 cm. longo, base 1.5–2 mm. lato, inde angustiore, inde gradatim ampliato, apice 5 mm lato, externe glanduloso-villoso, interne baseque villoso; sepalis rubris, lanceolatis, 12 mm. longis, 4 mm. latis, glanduloso pubescentibus, apice sub ulatis; petalis rubris, oblongo lanceolatis, 7–9 mm longis, 3 mm. latis, acutis, staminibus 8 et 6 mm longis, antheris 2 mm longis, stylo pubescente, sepala aequescente, bacca ellipsoidea, ca 1 cm longa.

Type: **Cajamarca, prov. Chota, Peru: pass south of Conchan, 2500 m.,** Dec. 7, 1938, *Stork and Horton 10073,* Field Museum Herb. 1052248 The reddish condition of the rather long hairs and the narrow leaves are characteristic of this proposed species, which seems near to *F. Fischeri,* but it has a shorter hypanthium and pedicels and red hairs It is a pleasure to name this for Dr Harvey Stork of Carleton College

(38) **Fuchsia furfuracea** Johnston

(Plate 6, fig 34)

Fuchsia furfuracea Johnston, Contr Gray Herb, 75.39, 1925

Shrubby, of unknown size, the branchlets dark, sparsely villous-hirsute, leaves opposite, oblong-ovate, obtuse to rounded at base, acuminate at apex, denticulate, brownish-pilose on both surfaces, especially on the veins beneath, with 11–13 principal lateral veins on each side of the midrib, blades 6–9 cm. long, 2 5–4 (5) cm wide, petioles 8–20 mm long, pubescent; stipules dark, subulate-lanceolate, 2–3 mm long, flowers few in terminal racemes, bracts pilose, 1–2 cm long, lanceolate, dentate, pedicels pubescent–pilose, 2–4 cm long, ovary elliptic, villous, 6–8 mm long, hypanthium red, tubular, 3 5–4 5 cm long, slightly enlarged at base, then constricted so as to be scarcely 2 mm wide for about half its length, then rather abruptly widened to 6–7 mm near the cylindrical summit, villous without and within, sepals red, somewhat spreading, lanceolate, 15–20 mm long, 4 mm wide, villous on backs, long-acuminate, with free tips 2 mm long in bud, petals purplish red, oblong-ovate, abruptly acutish, 9–10 mm. long; longer stamens two-thirds the sepals, shorter scarcely one-half the sepals, anthers 2 mm. long, style villous, slightly exceeding sepals; stigma 1 5 mm. thick, subcapitate, slightly 4-lobed, immature berry ellipsoid, barely 1 cm long.

Type locality, Yungas, La Paz, Bolivia Material seen, BOLIVIA. La Paz Yungas, *Bang 674,* type collection (F, GH, NY, US), Unduavi, at 3000 m, *Rusby 2511* (NY). Characterized by its long stipules and pedicels, brown pubescence, long sepal-tips, it seems near to *F Storkii, F hirtella,* etc, in its large leaves, narrow hypanthium, short terminal inflorescence The "*F peruviana*" of Johnston's text accompanying the original description is undoubtedly a misprint for *F boliviana*

(39) **Fuchsia Munzii** Macbride

(Plate 7, fig. 35)

Fuchsia Munzii Macbride, Field Mus Nat. Hist., Bot. Ser., 13, part 4, no. 1:559, 1941.

Shrub, the younger branches 1 5–3 mm. thick, very finely puberulent, apparently somewhat dark, leaves mostly opposite, sometimes ternate, broadly elliptic-lanceolate to -ovate or -obovate, subentire to inconspicuously denticulate, the principal lateral veins about 20 on each side of midrib, blades subcuneate at base, acuminate at apex, somewhat bicolored, quite glabrous, 6–15 cm long, 2 5–4 5 cm wide; petioles 4–10 mm long, stipules subulate-lanceolate, about 1 mm long, caducous; inflorescence a small terminal raceme or panicle, up to 1 dm long, with rather few flowers, very minutely strigulose bracts linear to lanceolate, 5–20 mm long, pedicels 5–15 mm long; ovary linear, 4–5 mm long, strigulose, hypanthium red, tubular, 4–5 cm long, slightly enlarged at base, then 1 mm wide, then very gradually ampliate and tubular, 4 mm wide, minutely and rather faintly puberulent without, pubescent within, sepals lanceolate, somewhat puberulent, 12 mm long, about 3 mm wide, acute, somewhat spreading, petals narrowly oblong, 11–12 mm long, acute, stamens 9 and 6 mm long, anthers 2 mm long, style pubescent in lower portion, extending about to sepal-tips; stigma subglobose, somewhat 4-lobed, 2 mm thick, berry subglobose, almost 1 cm long

Type collection, PERU Dept Junín Río Masamerich, 2100–2200 m, *Weberbauer 6648* (F, GH, US) This species suggests *F corymbiflora* from which it differs in its more glabrous leaves and rounder fruit

(40) **Fuchsia hirtella** H B K

(Plate 7, fig 36)

Fuchsia hirtella H B K, Nov Gen et Sp, 6 107, 1823

F caracasensis Fielding and Gardner, Sert Pl, pl 29, 1844, based on Linden 368, supposed to be from Caracas, Venezuela, in 1842 The plate and the specimen at US indicate synonymy with *hirtella*

Fuchsia miniata Planch and Linden, Fl des Serres, Ser I, pl. 8, 1852–1853; based on Linden collection from "Nouvelle Grenade." In my key would seem to run to *F Killipii* on basis of puberulent stems, but cannot be that, since the young growth is not canescent, so must be *hirtella* I have seen no specimen of Linden, labelled *miniata*.

Shrub to low tree, the younger branches apparently mostly reddish, 2–4 mm thick, terete, mostly rather densely pubescent with short somewhat appressed and interwoven hairs, older branches exfoliating freely, leaves in whorls of 3 or 4, lance-oblong to elliptic-ovate, rounded to cuneate at base, acute to acuminate at apex, remotely and indistinctly denticulate, strigulose and dark green above, more densely pubescent and paler beneath, membranaceous, with 10–15 principal lateral veins on each side of midrib and rather inconspicuous submarginal vein, the blades 6–12 (14) cm long, 2 5–4 (5) cm wide, petioles densely pubescent, 5–20 (35) mm long, stipules lance-linear, 1–2 mm. long, deciduous; flowers in terminal pendant corymbose racemes which may be grouped in a panicle 1–2 dm. long and equally wide; bracts lance-ovate, mostly 1–2 cm long, strigulose; pedicels more loosely pubescent, slender, mostly 5-10 mm. long; ovary oblong-fusiform, strigulose-pubescent, 5–7 mm. long, 1 5–2 mm thick; hypanthium tubular, rose-red, 3–3.5 (4 5) cm. long, 2 5–3 mm. thick at base, then 1.5–2 mm. for about one-third its length and very gradually widened until 6–8 mm. at summit, strigulose without, villous within lower half, sepals 4, red, somewhat divergent, lanceolate, acuminate, subulate for terminal 2 mm, 12–13 mm long, 2.5–3 mm wide, strigulose on backs, petals red, lance-oblong, glabrous, acutish, 11–14 mm long; stamens 10–14 and 6–10 mm long, glabrous, anthers 2–3 mm long, style red, filiform, almost or quite glabrous, exserted 4–8 mm beyond sepals, stigma subglobose, 4-lobed, ca 2 mm thick, berry ellipsoid, puberulent, 14 mm long, 6 mm wide

Type locality, in mts near Fusagasuga, Cundimarca, Colombia This species seems near to *F polyantha* and *F boliviana* in pubescence, leaves, inflorescence, hypanthium, etc, but distinct in its membranaceous leaves, ascending sepals, and long fruit It ranges rather widely in Colombia as can be seen from citation of representative material. COLOMBIA. without locality, *Mutis 1364* (US), *Bonpland Herbarium 1783,* probably type material, it is rather fragmentary, a condition referred to in the original description (fragment F) Antioquia · Tamesis, near Medellín, *Toro 965* (NY), San Pedro, *Tomás and Daniel 1306* (F) Caldas · Pinares, above Salento, 2600–2900 m, *Pennell 9195* (GH), *9324* (GH, NY, US); Volcancito, *Holton 893* (NY), Mediación-Quindio, *André 2152* (NY), "Laguneta" to "Magaña," old Quindio trail, 3000–3300 m, *Pennell 9418* (GH, NY, US); Salento to "Laguneta," *Pennell 9141* (GH, NY, US), "Laguneta" to "Magaña," *Pennell 9425* (GH) Tolima, "La Lora" to "Cucarronera," new Quindio trail, *Hazen 9679* (GH) Cundimarca near Bogotá, *Ariste-Joseph* (US), Sibate, 2900–3000 m, *Pennell 2517* (GH, NY, US), El Peñon, *Pennell 2435* (NY), Cortesito, pro de Mariquita, *Triana 3809 bis* (US), San Miguel, extremo W de la sabana de Bogotá, *Cuatrecasas 6657* (US) Cauca · "Paletara" to "Calaguala," 3000–3200 m, *Pennell 7083* (GH, NY, US), *7094* (GH, NY, US), "Canaan," Mt Purace, 3100–3300 m, *Pennell 6669* (GH, NY, US) Nariño Vulcán Galera, near Pasto, *Lehmann 5497* (GH, F, US) · Putumayo · Corregimiento El Encano, Laguna de la Cocha, Páramo El Tábano, *García B 7822* (US) There is considerable variation in amount of hairiness and the more southern more hairy specimens may represent *F. miniata,* but at present I am unable to separate it

(41) **Fuchsia polyantha** Killip, new species

(Plate 7, fig. 37)

Bush, up to about 1 m high; young stems quite simple, purplish red, minutely and closely appressed-puberulent under a lens, 2–4 mm thick, leaves not crowded, ternate or quaternate, rigid, more or less rugose, elliptic to broadly oblong-lanceolate, rounded to obtuse at base, acuminate at apex (the apex not in the same plane as the rest of the blade and bent at an angle in drying), subentire, light green and glabrescent above except for the appressed puberulence along the veins, about the same color beneath, minutely appressed-puberulent to almost glabrous and with prominent veins beneath, principal lateral veins 14–18 on each side of midrib, the submarginal not well formed, blades 6–10 (12) cm long, 2–3.5 cm. wide, petioles purplish, strigulose, 2–6 mm long; stipules dark, glabrous, subulate, 1.5–2 mm. long, promptly deciduous; inflorescence a compact, pendulous, strigulose, many-flowered panicle, 10–15 cm long, bracts lance-ovate, 1–2 cm. long, pedicels strigulose, purplish, 8–12 mm long, ovaries strigulose, purple, fusiform, 6–7 mm long; hypanthium purplish-red, tubular, 3.5 cm long, but little enlarged at base, 1.5 mm wide, then 1 mm wide for one-third its length and very gradually ampliate until 5 mm wide at summit, minutely strigulose without, pubescent within basal portion, sepals scarlet, divergent, linear-lanceolate, strigulose on backs, 13–15 mm. long, 2.5–3 mm wide at base, subulate at apex for 1.5–2 mm, petals crimson, oblong-oblanceolate, 10–12 mm long, 3.5–4 mm wide, subacuminate, glabrous, stamens 11–12 and 7–8 mm long, anthers 2 mm long, style quite glabrous, equalling or slightly exceeding sepals, stigma slightly longer than wide, 1–1.5 mm thick, berry ellipsoid, 8 mm long, 4.5–5 mm. wide

Frutex, 1 m altus, ramulis subpurpureis, minute strigulosis, 2–4 mm diametro, foliis ternatis vel quaternis, rigidis, subrugosis, ellipticis vel late oblongo lanceolatis, basi rotundatis vel obtusis, apice acuminatis, subintegris, subglabris vel in venis strigulosis, laminis 6–10 (12) cm longis, 2–3.5 cm latis, petiolis subpurpureis, strigulosis, 2–6 mm longis, stipulis glabris, subulatis, 1.5–2 mm longis, caducis, inflorescentia paniculata floribus multis, bracteis lanceolato ovatis, 1–2 cm longis, pedicellis strigulosis, subpurpureis, 8–12 mm longis, ovario striguloso, fusiformi, 6–7 mm longo; hypanthio purpureo rubro, tubuloso, 3.5 cm longo, basi 1.5 mm lato, inde 1 mm lato, gradatim ampliato, apice 5 mm lato, externe striguloso, interne pubescente, sepalis coccineis, divergentibus, lineari lanceolatis, strigulosis, 13–15 mm. longis, 2.5–3 mm latis, apice subulatis, petalis rubris, oblongo-oblanceolatis, 10–12 mm longis, 3.5–4 mm latis, subacuminatis, glabris, staminibus 11–12 vel 7–8 mm longis, antheris 2 mm longis, stylo glabro, sepalis aequalibus; stigmate 1–1.5 mm lato; bacca ellipsoidea, 8 mm longa, 4.5–5 mm lata.

Type: Dept. Nariño: between Mayasquer and Tambo, Colombia, 2800 m., Aug 2, 1935, *Mexia 7571*, U S Nat Herb 1662416 Another collection from ECUADOR Prov Carchi between Morán and Olivos, 3200–3500 m, July 10–13, 1935, *Mexia 7474* (US) The proposed species is near to *F hirtella* in puberulence, divergent sepals, inflorescence, etc, but has the leaves more rigid and heavily veined with a sharper apex, the style less exserted, the fruit shorter

(42) **Fuchsia corymbiflora** Ruiz and Pavón

(Plate 7, fig. 38)

Fuchsia corymbiflora RUIZ and PAVÓN, Fl Peruv, 3 87, pl. 325, 1802.

F corymbosa PRITZEL, Ind Ic, 1·469, 1866, apparently misspelling

F macropetala PRESL, Rel Haenk, 2 28, 1835, from Húanuco, Peru No specimen seen, but description fits here

F dependens HOOK, Ic Pl, 1·pl 65, 1837; based on *Jameson 81*, I am not sure of having seen it.

F velutina JOHNSTON, Contr. Gray Herb., 75·36, 1925.

Semiscandent shrub up to 4 or 5 m tall, the branches rather few, simple, the ultimate branchlets commonly 3–5 mm. thick, densely canescent-puberulent or -velutinous, leaves opposite, the blades elliptic to broadly oblong-lanceolate, subentire to inconspicuously denticulate, densely and minutely soft-puberulent on both surfaces, rounded to obtuse at base, acuminate at apex, 6–11 cm long, 3–5 cm. wide, the principal lateral veins 14–16 on each side of the midrib, with evident submarginal vein, petioles 6–14 (18) mm. long, velutinous; stipules lance-deltoid, about 1 mm. long, caducous, flowers terminal, few to rather many, racemose to corymbose, the bracts oblong-linear to -lanceolate, 8–15 (20) mm long, pedicels 6–10 (12) mm. long, velutinous; ovary ellipsoid, puberulent, 5–6 mm. long, hypanthium tubular, scarlet, 3 5–6 cm long, slightly dilated beyond ovary, then 1 5–2 mm wide and very gradually ampliate until 5–7 mm. wide at summit, puberulent without, pubescent within much of its length, sepals lance-linear, erect-divergent, scarlet, 12–15 mm long, 3–3 5 mm wide, acute to acuminate, puberulent on backs; petals deeper red, narrow-oblong, 13–16 mm long, about 3 mm wide, acute to obtusish, stamens 10–11 and 8–9 mm long, with reddish filaments, anthers 2 mm long, style pubescent in lower part, reddish, exceeding sepals by a few mm ; stigma subglobose, slightly lobed, 2 5–3 mm wide, fruit round-ellipsoid, densely puberulent, 6–10 mm long, 4–6 mm wide

Type locality, Chinchao, Húanuco, Peru As here treated this species is quite different from the usual concept I agree with Johnston (Contr Gray Herb 75.37 1925) that most material which has been treated as *corymbiflora*, including illustrations, is *boliviana*, but I feel he erred in saying that the former had a glabrous inner surface to the hypanthium In fact, I do not see what he did include in *corymbiflora* However, the Ruiz and Pavón specimen now available at Field Museum reveals definitely what it is and shows it to be a plant of very minute soft pubescence, rather short round-ellipsoid fruits, and agreeing with material occurring from Ecuador to north central Peru and including *F. dependens* and *velutina*.

Representative material is, ECUADOR: In Andibus Ecuadoriensibus, *Spruce 5471* (NY). Prov Carchi Guaca San Gabriel, 3800 m, *Balls 7344* (US), Canton Tulcan, near Pun, 2987 m, *Mexia 7595* (POM, US). Prov Pichincha west side, Pichincha, 2700 m., *Jameson*, possible type coll dependens (GH, NY, US), Canton Quito, road Cotocallao near Nono, 2987 m, *Mexia 7658* (POM, US); between Calacati and Nono, *Hartweg 986* (NY) Prov Cotopaxi? Hacienda Sumbagua, 3600 m, *Haught 2942a* (US). PERU *Ruiz and Pavón*, ex Herb Madrid, probably from Húanuco (F) Húanuco · Yanano, 2300m, *Macbride 3715*, type no velutina (F, GH); road Mirador to Chanchao, 2300 m, *Mexia 7765* (GH, US), Carpis, road Acamayo to Chinchao, 2800 m., *Mexia 04129* (GH)

(43) **Fuchsia abrupta** Johnston

(Plate 7, fig 39)

Fuchsia abrupta Johnston, Contr. Gray Herb., 75:37, 1925

More or less scandent shrub, with glabrous divaricate twigs 4–5 mm thick; leaves opposite, subcoriaceous, lance-elliptic to broadly oblanceolate, 7–12 cm. long, 2.5–4 cm. wide, subentire, gradually narrowed at base, acuminate at apex, dark green and subglabrous above, paler and puberulent beneath especially along the veins, principal lateral veins about 20 on each side of midrib, submarginal vein evident, petioles pubescent, 4–8 mm. long, stipules lance-deltoid, 2–3 mm. long, deciduous, inflorescence a terminal pendant raceme, 1–2 dm. long, bracts reflexed, lanceolate, 8–18 mm. long, somewhat loose-pubescent, pedicels 2.5–4 cm. long, quite glabrous, ovary linear, glabrous, 6–8 mm. long, 1 mm. wide, hypanthium scarlet, tubular, 3.5–4.5 cm. long, somewhat nodose at very base, then 1 mm. thick, then gradually ampliate until 4–5 mm. wide at summit, glabrous without, pubescent within lower portion; sepals scarlet, lanceolate, 13–15 mm. long, acuminate, erect-divergent, the tips subulate for 1.5–2 mm., petals oblong, obtuse, 14–15 mm. long, stamens 10 and 8 mm. long, anthers 2 mm. long; stigma subglobose, slightly lobed, 2 mm. wide, fruit cylindric-oblong, 12–14 mm. long, 4 mm. wide.

Type collection from Cushi, dept. Húanuco, Peru, at 1600 m., *Macbride 4541* (F, GH, US). This is the only collection I have seen; it has glabrous stems, narrow leaves, long pedicels and glabrous hypanthium.

(44) **Fuchsia Cuatrecasasii** Munz, new species

(Plate 7, fig. 40)

Shrub; young twigs glabrous except sometimes toward the inflorescence, greenish, 2–4 mm. thick; leaves opposite, membranaceous, not crowded, elliptic-ovate, rounded to obtuse at base, acute to subacuminate at apex, subentire, light green and quite glabrous above, mostly glabrous beneath except for some exceedingly minute appressed puberulence along the veins, principal lateral veins 10–12 on each side of midrib, submarginal weakly developed, blades 4–16 cm. long, 2–9.5 cm. wide, petioles more or less strigulose, 2–18 mm. long, stipules deltoid, more or less connate and persistent, 1–1.5 mm. long, flowers few, in short terminal racemes, bracts lanceolate, 5–15 mm. long, pedicels slender, 7–18 mm. long, almost glabrous; ovary glabrous, ellipsoid, purplish red, 4–5 mm. long, 1.5–2.5 mm. wide; hypanthium bright red, 29–40 mm. long, 2–3 mm. wide at base, then slightly narrowed for one-third its length, then gradually ampliate until 6–8 mm. wide at summit, glabrous to sparingly pubescent without, densely pilose within, sepals scarlet, divergent, 10–13 mm. long, 4–5 mm. wide, glabrous, subulate at apex for about 1 mm.; petals scarlet, narrowly oblong-ovate, 8–10 mm. long, about half as wide, somewhat pointed, glabrous, stamens 7–8 and 5–6 mm. long, anthers 1 mm. long; style sparsely pubescent, not equalling petals; stigma barely 1 mm. thick, berry apparently oblong-ellipsoid.

Frutex, ramulis glabris, 2–4 mm. diametro, foliis oppositis, membranaceis, elliptico-ovatis, basi rotundatis vel obtusis, apice acutis vel subacuminatis, subintegris, subglabris, laminis 4–16 cm. longis, 2–9.5 cm. latis, petiolis strigulosis, 2–18 mm. longis; stipulis deltoideis, connatis, 1–1.5 mm. longis, floribus paucis, in racemis, bracteis lanceolatis, 5–15 mm. longis; pedicellis tenuibus, 7–18 mm. longis, ovario subglabro, ellipsoideo, 4–5 mm. longo, 1.5–2.5 mm. lato, hypanthio rubro, 29–40 mm. longo, basi 2–3 mm. lato, inde angustiore, inde ampliato, apice 6–8 mm. lato, exteriore subglabro, interiore piloso; sepalis coccineis, divergentibus, 10–13 mm. longis, 4–5 mm. latis, glabris, 1 mm. subulatis; petalis coccineis, anguste oblongo-ovatis, 8–10 mm longis, staminibus 7–8 vel 5–6 mm longis; antheris 1 mm longis, stylo sparse pubescente, stigmate 1 mm. lato; bacca oblongo-ellipsoidea

Type. from **Comisaría del Cáqueta, Colombia: Cordillera Oriental, vertiente oriental Quebrada del Río Hacha, bosque abierto en Cajón de Pulido, 1700 m. alt.**, March 26, 1940, *J. Cuatrecasas 8738*, U. S. Nat Herb 1796401 An additional collection from the Com de Putumayo, COLOMBIA, is from between El Silencio and La Cabaña (carretera de Sibundoy a Urcusique), at 2200–2400 m , Dec 31, 1940, *Cuatrecasas 11495* (US) The species seems quite near *F abrupta* of Peru, but has shorter leaves with fewer veins, shorter sepals, shorter inflorescence and pedicels

(45) **Fuchsia Killipii** Johnston

(Plate 8, fig 41)

Fuchsia Killipii JOHNSTON, Contr Gray Herb , 81 94, 1928

Somewhat scandent shrub, up to 4 m tall, the younger branches brownish, subterete, somewhat puberulent, leaves opposite or ternate, elliptic, acute at base, acute to acuminate at apex, subentire, almost equally green on both surfaces, somewhat coriaceous, with about 12 principal lateral veins on each side of the midrib and evident submarginal vein, subglabrous to minutely strigulose on both surfaces, the blades 5–9 cm long, 2–3.5 cm wide; petioles 5–10 mm long, stipules deltoid, scarcely 1 mm long, deciduous, flowers in upper axils and in terminal drooping racemes or panicles, rather numerous, bracts elliptic-ovate, 1–2 (3) cm long, pedicels subfiliform, 1–2 cm long at anthesis, 2–4 cm. long in fruit, subglabrous, ovary round-ellipsoid, inconspicuously puberulent, 3–4 mm long, hypanthium red, tubular, 3–4 cm long, 1 5–2 mm wide at the base, then narrowed for one-third its length, then rather abruptly widened until 5–7 mm at summit, glabrous without, retrorse-villous within; sepals lanceolate, divergent, acuminate, 14–15 mm long, 4 mm wide, somewhat puberulent toward apex of outer surface, subulate 1–1 5 mm at tips; petals bright red, oblong-oblanceolate, 13–15 mm long, 2 5–4 mm wide, obtuse to short-acute, glabrous, stamens 12–13 and 9–10 mm long, glabrous, anthers white, 2 mm. long; style villous through much of its length, up to 5 mm longer than sepals; stigma 4-lobed, subglobose, 1 5 mm long, berry globose, 5–6 mm. thick.

Type locality, Río Suratá above Suratá, Santander, Colombia The species is distinguished from its closest relatives by having fewer veins, smaller fruit, and longer pedicels I have seen the following collections from COLOMBIA · Santander Río Suratá valley, above Suratá, 2000–2300 m , *Killip and Smith 16695*, type coll (GH, NY, US), *16604* (GH, US) , near Charta, 2600 m , *Killip and Smith 18854* (GH, NY, US), *17459* (GH, NY, US) , near La Baja, 2200–2600 m , *Killip and Smith 16776* (F, GH, NY, US)

(46) Fuchsia boliviana Carr.

Fuchsia boliviana Carr., Rev. Hort., 1876 150, with fig., 1876.

Bushy shrub or small tree up to 4.5 (6) m. high, with rather open branching, the branchlets spreading or dependent, mostly 2–4 (5) mm. thick, terete to angled, densely pubescent; leaves opposite, sometimes alternate or ternate, elliptic to oblong-lanceolate or -ovate, obtuse to rounded at base, acute to acuminate at apex, usually somewhat denticulate, soft-pubescent on both surfaces to pilose or puberulent or glabrescent, somewhat paler beneath, with about 12–24 principal lateral veins on each side of midrib; leaf-blades 5–15 (20) cm. long, 3–6 (10) cm. wide; petioles 1.9–3 (4.5) cm. long, pubescent; stipules subulate-lanceolate, scarcely 1 mm. long, deciduous; flowers few to many, in terminal drooping pubescent corymbs or panicles which elongate in fruit; bracts 7–20 (30) mm. long, 3–9 mm. wide, usually lanceolate and reflexed; pedicels 5–15 mm. long; ovary oblong-linear, 5–7 mm. long, 1.5–2 mm. thick; hypanthium tubular, usually dark red, 3–6 cm. long, slightly enlarged at base, then 1.5–2 mm. wide and very gradually ampliate until 3.5–7 mm. at apex, more or less pubescent without and within; sepals usually dark red, lanceolate, acuminate, 10–20 mm. long, 2.5–5 mm. wide, spreading-reflexed in anthesis, more or less pubescent without; petals dark to light red, erect to divergent, oblong, 9–13 mm. long, 3–4.5 mm. wide, acute; episepalous stamens equaling or slightly exceeding petals, alternate three-fourths as long; filaments glabrous, reddish; anthers light in color, 2–3 mm. long; style slender, pubescent within hypanthium, scarcely reaching tips of sepals; stigma subglobose, slightly lobed, 1–2 mm. thick; berry oblong-ellipsoid, 1–2 cm. long, 4–6 mm. thick, pubescent.

As here understood, this species is common and widespread, including most of the material once referred to *F. corymbiflora*, from which it can be distinguished by its usually longer and more spreading hairs, spreading sepals, apparently less vinelike habit, more apiculate buds and elongate fruit.

Key to Varieties of *Fuchsia boliviana*

A. Hypanthium 3–4 cm. long; sepals 10–18 mm. long. South of Ecuador.
  B. Plant pilose or pubescent with spreading hairs. Peru to Argentina. 46a. var. *typica*.
  BB. Plant minutely puberulent. Bolivia. 46b. forma *puberulenta*.
AA. Hypanthium 5–6 cm. long, sepals 17–21 mm. long. North of Ecuador. 46c. var. *luxurians*.

(46a) Fuchsia boliviana Carr. var. typica Munz, new name

(Plate 8, fig. 42)

F. boliviana Carr., Rev. Hortic., 1876 150, with pl., 1876; Johnston, Contr. Gray Herb., 75:37, 1925.
F. corymbiflora of many authors, not of Ruiz and Pavón, 1802.

Plant usually soft-pilose or -pubescent on all new growth; hypanthium 2.5–4 cm. long; sepals mostly 12–18 mm. long.

Type locality, "sur les montagnes à la Bolivie, à 6000 mètres environ d'altitude." Such an altitude is quite impossible; I have seen specimens from as high as 4000 m ; the variety ranges from Peru to northern Argentina In the southern part of the range the plants tend to be less densely pilose and smaller-flowered. Representative material may be cited as follows, PERU Húanuco. 5 km SE. of Carpish, 2850 m., *Stork 9921* (F). Huancavelica: at 2400 m, *Weberbauer 6565* (F, GH). Ayacucho: Prov. de la Mar, Tambo, *Weberbauer 5555* (F, GH, US); Ccarrapa, between Huanta and Río Apurimac, 2800 m, *Killip and Smith 22280* (NY, US) Apurimac. Abancay. Ampuy, 3100 m, *Stork, Horton and Vargas 10595* (F); Huancarama, 3200 m., *West 3783* (GH) Cuzco · Urubamba Valley, *West 6462* (GH, US), *Herrera 2094* (US), *1123* (F, US), Paucartambo, *Balls 6715* (US); Ollantaytambo, *Cook and Gilbert 290* (US) BOLIVIA La Paz. Yungas, *Bang 327* (F, GH, NY, US), *Rusby 1071* (F, GH, NY, US); Soratá, 2600–2800 m, *Mandon 622* (F, GH, NY, US) Santa Cruz Samaipata, 1800 m, *Steinbach 3755* (POM), Comarapa, *Steinbach 8459* (GH, NY). Cochabamba Prov Chapare: Incacorral-Aduana, 2700 m, *Steinbach 9538* (F); Prov Sacaba Cerro de Incachaca, 2500 m, *Steinbach 5763* (F, GH, US) ARGENTINA Jujuy. San Lorenzo, *Joergensen 36041* (POM) Tucumán Depto Chichigasta, Estancia Las Pavas, *Venturi 4657* (F, US), Villa Nougués, 1200 m., *Munz 15469* (NY, POM, US), Las Lenguas al Clavillo, 1750 m, *Munz 15475* (POM); Depto Famaillá. Quebrada de Lules, *Venturi 1295* (F, CAS, GH, US).

(46b) Fuchsia boliviana Carr forma puberulenta Munz, new form

Plant with dense minute subappressed puberulence, hypanthium 3–4 cm long; sepals mostly 10–16 mm long (Planta cum puberulencia minuta et densa hypanthio 3–4 cm longo)

Type: from **La Paz, Bolivia: Nor Yungas: Milluguaya, 1800 m.,** *Buchtien 732*, Field Mus no 588700, isotypes F, GH, NY, US Other material all from BOLIVIA. La Paz Unduavi Valley, 2000–2600 m, *Bro Julio 478* (US), Nor Yungas Coroica to La Paz, *Mexia 04286* (GH), Sur Yungas. Sirupaya near Yanacachi, 2100 m, *Buchtien 732* (F, GH), Colaya, *Mexia 7809* (F, US) Cochabamba · Prov Chapare, 110 km north east of Cochabamba, near Chimore, 800 m, *Eyerdam 24740* (F) This form resembles *F corymbiflora* in puberulence, though the latter has it less dense, but *F. boliviana* has spreading sepals and *corymbiflora* does not.

(46c) Fuchsia boliviana Carr. var. luxurians Johnston

Fuchsia boliviana Carr. var *luxurians* Johnston, Contr. Gray Herb, 75 38, 1925.

F cuspidata Fawcett and Rendle, Journ Bot., 64 105, 159, 1926, as to type cited: Harris 5825

F. corymbiflora of many authors Lindl, Bot. Reg, 26 pl. 70, 1840; Hook., Bot Mag., 69 pl. 4000, 1843, not of R and P., 1802.

Plant soft-pilose to -pubescent; hypanthium 5–6 cm long; sepals 17–21 mm. long.

Type locality, Colonía Tovar, Venezuela Representative material, JAMAICA . Cinchona, *Harris 7643* (NY), *Harris and Lawrence C15438* (NY); St Helen's Gap, St Andrew, *Maxon and Killip 571*, 1475 m (F, GH, NY, US) GUATEMALA Cartago Cartago, 1350 m , *Smith 4804* (US) , Zacatepéquez: San Rafael, 2000 m , *Smith 2176* (US) San Marcos. Tájumulco, northwest slope of Volcán Tájumulco, 2300 m , *Steyermark 36510* (F) Chimaltenango · San Marcos, *Johnson 1231* (F) EL SALVADOR bought in market of San Salvador, brought from Volcán de San Salvador, *Calderón 2345* (F, US) COLOMBIA Antioquia "Las Minitas," so of Caldas, 2650 m , *Pennell 10970* (GH, NY) , Medellín, *Toro 721* (NY) Caldas Salento to "Lagunita," old Quindio trail, 2000 m , *Pennell 10594* (GH) Cundimarca Bogotá, 2700 m , *Schultze 135* (US), *Perez 4802* (US) VENEZUELA Colonía Tovar, 1800–2000 m , *Pittier 9252*, type no (GH, NY, US), *Allart 354* (NY, US), *Jahn 439* (US)

(47) **Fuchsia fulgens** DeCandolle

(Plate 8, fig 48)

Fuchsia fulgens DC., Prodr , 3 39, 1828, in Sessé and Moçiño, Icon Fl. Mex. ined , 362, LINDLEY, Bot. Reg , 24·1, 1838; CURTIS, Bot Mag , 67 .3801, 1840; HEMSLEY, Biol Centr Amer , Bot., 1 457, 1880; STANDLEY, Contr U. S. Nat Herb., 23 1078, 1924.
Ellobium fulgens LILJA, Linnaea, 15 262, 1841

Shrub, commonly 3–12 dm tall, with tuberous-thickened roots, soft woody stems, few-branched, young branches sparsely pubescent, these and the leaves tinged red; leaves broadly ovate to oblong-ovate, opposite, paler beneath than above, fine-pubescent on both surfaces, rounded to more or less cordate at base, abruptly short-acuminate, shallowly and evenly serrulate, the blades thin, 5–17 cm long, 3–12 cm. wide, with about 10 principal lateral veins on each side of the midrib, petioles 1 5–10 cm long; flowers several, in short racemes with an axis 5–20 cm long, lower bracts leafy and ovate, 1–3 cm long, upper reduced, lanceolate, 0 5 cm long, puberulent, pedicels pendant, very slender, 1–2 (3 5) cm long, hypanthium 5–6 5 cm long, about 2 mm wide at base, then scarcely narrowed and then gradually ampliate until 5–7 mm wide near mouth, dull scarlet, subglabrous to puberulent without, pubescent within, sepals 4, yellowish to greenish with somewhat pale or yellow or red base, ovate-lanceolate, 12–14 mm long, subglabrous except for the sparse pubescence near the acuminate tips, petals bright red, oblong-ovate, obtuse, 8 mm. long, 6 mm. wide; stamens about 10 and 7 mm long, anthers 2–3 mm long, filaments whitish to reddish, style filiform, pink, pubescent near base, slightly exceeding sepals, stigma greenish, subconic, 2 mm long, fruit ellipsoid, subglabrous, dark, 2 or more cm long

Type locality not known, the species is Mexican, is near to such long-tubed species as *F bolwiana, corymbiflora*, etc , but quite distinct in its green sepals and leaves of *cordifolia* type It may be an epiphyte, may grow on ledges, walls, or more open ground Material seen, "Fuchsia cordifolia N. No 195 t.

2 f 159 i c. 195," *Sessé, Mociño et al 5211* (F); photo of Geneva copy of Sessé and Mociño plate (F); H B Basil, Aug 1841 (NY). MEXICO · Mexico City, *Russell and Souviron 132* (US) Mexico. Temascaltepec District, Rincon, *Hinton 1144* (GH, US) Michoacán near Tarascon, *Pringle 11988½*, at 2000 m, (F, GH, US), near Patzcuaro, *Pringle 4123* (F, GH, MICH, NY, POM, US), Morelia, Campanario, 2200 m, *Arsène in 1911* (US); Monte San Miguel, *Arsène 6673* (US), 2 miles north of Zitacaura, *Hitchcock and Stanford 7207* (US); Tancitaro, *Leavenworth 303* (F) Jalisco Volcano Colima, 2100 m, *Goldsmith 22* (GH).

(48) **Fuchsia decussata** Ruiz and Pavón

(Plate 8, fig 44)

Fuchsia decussata RUIZ and PAVÓN, Fl Peruv., 3:88, pl 323, fig b, 1802

F scandens KRAUSE, Fedde Rep, Nov sp 1:171, 1905, based on Weberbauer 3324 from Monzon, Húanuco, Peru; have seen photograph.

F fusca KRAUSE, Engl, Jahrb, 37 599, 1906, based on Weberbauer 4975 from near Cuzco, have seen photograph, flowers large like Macbride 4414

F fontinalis MACBR., Candollea, 8 25, 1940 Reduced by Macbride, Field Mus Nat Hist, Bot, 13, part 4 552, 1941

Shrub, supported by other vegetation, up to 3 m high, with long flexuous branches, the youngest reddish, 1–3 mm thick, densely brown-pubescent with incurved hairs, leaves ternate or opposite, numerous, those of main stems often remote and supplemented by smaller ones on reduced lateral branchlets, coriaceous, elliptic to elliptic-lanceolate or -ovate, cuneate at base, acute at apex, serrate to serrulate, dark green and puberulent to strigulose to glabrescent above, paler and short-pilose beneath, especially along veins, principal lateral veins 6–10 on each side of midrib, submarginal vein somewhat developed, blades 1 5–5 cm. long, 0 5–1 5 (2) cm wide, petioles pubescent-pilose, 3–8 (15) mm. long, stipules dark, subulate, 1–1.5 mm long, persisting, flowers solitary in axils; pedicels subfiliform, pilose, 1 5–3 cm long; ovary ellipsoid, 3–4 mm. long, more or less pilose, hypanthium 13–16 (22) mm. long, red, 2–3 mm wide at base, then very little narrowed, 3 5–4.5 mm. wide at summit, sparsely pilose without, glabrous within, sepals divaricate, lance-oblong, red with green tips, acute, 7–9 (11) mm long, 2 5 mm. wide, sparsely pilose on backs; petals red, oblong-obovate, obtusish to apiculate, 6–7 (10) mm long, 3–4 mm wide, stamens 8–9 and 6–7 mm long, more or less exserted, anthers 1 5–2 mm long; style glabrous, equaling or exceeding sepals by 2–3 (6) mm; stigma 1 5 mm. wide, fruit red, oblong, obtusely angled, 8–10 mm. long, 5–6 mm thick.

Type locality, Muña, dept Húanuco, Peru The species ranges at elevations of 2800–3400 m from Húanuco to Cuzco It has considerable variation in width and acuteness of petals. It falls in a group with axillary flowers and short hypanthium and seems to be a possible derivative from the *cordifolia* type Macbride (Field Mus Nat. Hist Bot. Ser 13, part 4, no 1·554, 1941) maintains *F fusca* as a species on the basis of the wider petals and brownish pubescence, but this latter character seems to be a general tendency in many specimens. Representative material of *F decussata* are· PERU: without definite locality given, *Ruiz and Pavón, F decussata* sp nov Herb at Geneva (photo F, POM), ex Herb Madrid (F) Húanuco· 15 miles SE of Húanuco, 2900 m, *Macbride and Featherstone 2124* (F, GH, US), *2081* (F, GH, US), *2107* (F, GH, US), Panao, *Macbride 3615* (F, GH, US), Tambo de Vaca, *Macbride 4414* (F, GH) with petals 10 mm long, Carpish, *Stork and Horton 9911* (F) with very narrow petals, Carpia, between Acomayo and Chinchos, *Mexia 04126* (GH), *04128* (GH), Monzon, *Weberbauer 3324*, type *scandens* at Berlin (photo F, POM) Ayucucho· prov Huanta, between Tambo and Apurimac River, *Weberbauer 5578* (F) Cuzco between Cuzco and Santa Anna, below Yanamanche, *Weberbauer 4975*, type *fusca* at Berlin (photo F, POM)

(49) **Fuchsia hypoleuca** Johnston

(Plate 8, fig 45)

Fuchsia hypoleuca JOHNSTON, Contr Gray Herb, 75 34, 1925

Shrub, 1–2 m high, young stems densely canescent-pubescent with more or less incurved hairs, slender, 1 5–3 (4) mm thick, leaves opposite or ternate, rigid, crowded, lanceolate, obtuse to acute at base, acute at apex, remotely serrulate in upper half, more or less revolute, veiny almost rugose, greenish and somewhat strigulose above, pale and densely pilose-pubescent beneath, tending to have interwoven fungus mycelium underneath, principal lateral veins 6–10 on each side of midrib, submarginal vein present, blades 3–6 (7 5) cm long, 0 8–1 7 cm wide, petioles pubescent, 5–10 mm long, stipules subulate, 2–3 mm long, deciduous, pedicels few, solitary in axils, filiform, pendulous, pubescent, 1 5–2 cm long, ovary ellipsoid, pubescent, 4 mm long, hypanthium red, 18–23 mm long, about 2 5 mm wide at base, then somewhat narrowed and then gradually ampliate until 5 mm wide, pubescent and villous within lower half, sepals divaricate, scarlet, lanceolate, 9–12 mm long, 3 mm wide, pubescent on backs, subulate for 1 mm at apex, petals scarlet, obovate, 7 mm long, 4–5 mm wide, rounded at apex, stamens 7–8 and 5–6 mm long, anthers 1 5 mm long, style pubescent within the hypanthium, equalling the sepals or exceeding them by 2–3 mm, stigma green, 1 5 mm wide; fruit apparently oblong-ellipsoid, 4-angled, 8–10 mm long, 3–4 mm. wide.

Type locality, between Loja and San Lucas, prov Loja, Ecuador. The species seems to me in its floral position and hypanthium shape to be near *F decussata*, but amply distinct in the narrow crowded leaves which are whitish beneath. I have seen the following specimens, ECUADOR: without definite locality, *Jameson* (F, US), southern provinces, *Jameson* (US); between Loja and San Lucas, 2100–2600 m *Hitchcock 21440*, type coll. (GH, NY, US).

(50) **Fuchsia scabriuscula** Bentham

(Plate 8, fig. 46)

Fuchsia scabiuscula Benth., Pl. Hartweg, 177, 1845.

Spreading shrub, 7–20 dm. tall, the younger twigs sometimes reddish, 2–4 mm. thick, densely pilose with white to somewhat brownish hairs; leaves opposite, elliptic to elliptic-obovate, rigid and very veiny, even rugose, rounded to obtuse at the base, acute to subacuminate at the apex, subentire, somewhat strigose above, paler and pilose beneath, especially on veins, with 10–15 principal veins on each side of midrib and with prominent submarginal vein, blades 3–10 (13) cm. long, 1.5–5 (7) cm. wide; petioles 5–25 mm. long, densely pilose, stipules subulate, pubescent, 1.5–3 mm. long, quite persistent, pedicels solitary, axillary, slender, curved, pilose, 1–2 cm. long; ovary narrowly fusiform, densely pilose, 5–7 mm. long, hypanthium bright red, 15–18 mm. long, 1.5–2 mm. wide at base, then somewhat narrowed, then gradually ampliate until 4.5–5 mm. wide at summit, densely pilose without and within the basal half, sepals bright red, divergent, lance-oblong, 8–9 mm. long, ca. 3 mm. wide, subulate at apex for about 1.5 mm., pilose on back; petals red, obovate-oblong, 8–9 mm. long, about 0.5 mm. wide, rounded at apex, stamens about 8 and 6 mm. long, anthers 1.5 mm. long; style densely pubescent within hypanthium, extending about to tips of petals; stigma greenish, about 2 mm. wide, fruit oblong, 10–12 mm. long, 3–4 mm. wide.

Type locality, "In declivities occidentali Andium Quitensium." Ecuador. This species with *F. verrucosa* seems to me to be near *F. decussata*, but with a somewhat more narrow base to the hypanthium. It is characterized by the very veiny, rugulose leaves, pilose stems and flowers, and short hypanthium. It seems to be confined to Ecuador, from which I have seen the following material: in Andibus Ecuadorensibus, *Spruce 5038* (GH, NY). Pichincha: in declivitate occidentali Andium Quitensium, *Hartweg 987*, type no., Geneva Herb. (photo F, POM; leaf F), Sive Andium Quitensium, 2500 m., *Jameson 53* (NY), *92* (GH); between Baeza and Papallacta, 2000 m., *Mexia 7339* (GH, US), Nanegal District, *Couthouy in 1855* (GH), west declivity of Pichincha, *Jameson 7* (NY). Tungurahua: Valley of Pastaza River, between Baños and Cashurco, 1300–1800 m., *Hitchcock 21781* (GH, NY, US); Vulcán Tungurgua, *Lehmann 4995* (F). A collection from Huigra, by *Rose and Rose, no. 22477* (US) is near this but the leaves are thin.

(51) **Fuchsia verrucosa** Hartweg

(Plate 8, fig. 47)

Fuchsia verrucosa Hartweg, in Benth., Pl. Hartweg, 178, 1845.

F. perbrevis Johnston, Contr. Gray Herb., 75:30, 1925.

Shrub 1–2 m. high, young twigs subglabrous, slightly red, 2–4 mm. thick; leaves opposite or ternate, thick and firm, elliptic-ovate to ovate-oblong, acute to acuminate at base, acuminate at apex, subentire to somewhat serrulate, quite glabrous above, paler and subglabrous beneath, or puberulent on the veins; veins very prominent beneath, the principla lateral ones about 15 on each side of the midrib, submarginal prominent; blades 4–12 cm long, 2 5–5 5 cm wide, petioles 2–10 mm long; stipules more or less connate, reflexed, about 2 mm long, flowers few, solitary, axillary, pedicels firm, glabrous, 1–2 5 cm long, recurved at anthesis, ovary subglabrous, 10–12 mm long, about 2 mm wide, 4-angled, hypanthium obconic, 3–5 mm long, subglabrous without and within, sepals 8–10 mm long, 2–3 mm. wide, lance-oblong, divergent, acutish, bright red, petals red, obovate, 8–9 mm long, 4–5 mm wide; stamens 3–4 mm long, anthers 1 5 mm long, style glabrous, 7–9 mm long; stigma 1 5 mm thick; fruit 4-angled, 15–18 mm long, 3 5–4 mm wide

Type locality, between "Páramo de San Fortunato et pagum Fusagasuga, prov Bogotá," Colombia The species seems to be nearest to *F scabriuscula*, with which it agrees in its thick veiny leaves, but is remarkable, as has been pointed out both by Bentham and Johnston in their descriptions, for its very short hypnathium I have seen the following collections, all from COLOMBIA · without definite locality, *Mutis 2077* (US), *2047* (US), *1361* (US) Dept Santander del Norte road Pamplona to Toledo, 2800–3000 m, *Killip and Smith 19976* (GH, NY, US), *19831* (F, GH, NY, US) Cundimarca: between Páramo de San Fortunato and Fusagasuga, prov Bogotá, *Hartweg 991*, type no *verrucosa*, Berlin specimen (photo F, POM), Geneva specimen (leaf F); Flora Neo-granadina-Bogotana, Ultra Abate (ultra Ubate ?), *Holton 892*, type *perbrevis* (GH) Huila · Comisaría del Caquetá Cordillera Oriental, en Gabinete, 2300–2450 m, *Cuatrecasas 8465* (US)

(52) **Fuchsia sanctae-rosae** O Kuntze

(Plate 9, fig 48)

Fuchsia sanctae rosae O Kuntze, Rev Gen, III, pt 2.98, 1898

F boliviana Britton, Bull Torrey Bot Club, 17 214, 1890, not Carr, 1876

F Brittonii Johnston, Contr Gray Herb, 75·39, 1925, new name for *boliviana* Britton

F Weberbaueri Krause, Fedde Rep Nov Sp, 1 170, 1905, based on Weberbauer 661, of which I have seen a photograph

F filipes Rusby, Mem. N. Y. Bot. Gard, 7:317, 1927, based on White 232, which I have seen

From suffrutescent or almost herbaceous and 3–5 dm tall, to shrubby and 2–3 m high, rather simple to many-branched, erect to semidecumbent, young shoots mostly glabrous, sometimes somewhat pilose, purplish red, 1.5–4 mm thick; leaves mostly in whorls of 3 or 4, firm, elliptic-lanceolate to almost -obovate, obtuse to acute at base, acute to acuminate at apex, subentire to minutely serrulate, deep green and glabrous above, lighter and glabrous beneath except usually somewhat pilose along midrib, principal lateral veins 8–12 on each side of midrib, submarginal frequently not very evident, blades 3–10 cm long; 1 5–4 cm. wide, petioles 5–20 mm. long, usually purplish red and glabrous, sometimes appressed-pubescent; stipules subulate, 1–2 mm long, sometimes reflexed, sometimes connate, deciduous; flowers rather numerous, but solitary in upper axils of somewhat reduced leaves, hence more or less racemose, pedicels very slender, 1–2.5 cm long, mostly glabrous, ovary narrow ellipsoid, glabrous to puberulent, 4–6 mm long; hypanthium deep to bright red, 13–18 (22) mm long, 2–2.5 mm wide at base, then slightly narrowed and then gradually ampliate until about 4 mm wide at summit, glabrous without, pilose within the lower half, sepals scarlet, lance-oblong, 8–10 mm long, 2.5–3 mm. wide, glabrous or sometimes pilose, acutish, petals orange-red to scarlet, oblong-obovate, 6–8 mm long, 3–6 mm wide, obtuse to acutish, sometimes almost 3-toothed; stamens 7–9 and 5–7 mm. long; anthers about 1.5 mm long, style mostly glabrous, extending about to the sepal-tips, stigma red, about 1 mm wide, berry varying from globose-ellipsoid to oblong-ellipsoid, 6–10 mm. long, 4–5 mm wide

Type locality, Santa Rosa, Bolivia (there are several towns of this name in Bolivia) I have not seen the type. The species is variable in every way, but I cannot find any constant characters for division It comes between the racemose and axillary-flowered groups with short hypanthium, so seems to stand between the species I have just treated and those like *Osgoodii, Andrei,* etc, which follow It ranges at altitudes between 2000 and 3000 m, in southern Peru and Bolivia Representative material, PERU · Dept Cuzco "Pillahuata," Cerro de Cusilluyoc, *Pennell 13997* (F, GH, NY, US), *13956* in part (GH); prov Paucartambo, valley of Río Tambomayo, *West 7091* (GH), Macchu-Picchu, *Munz 15548* (POM), *West 6414* (GH), *Mexia 8078* (F, GH, US), *Balls 6803* (US) Puno Sandía, *Weberbauer 661,* type *Weberbaueri* at Berlin (photo F, POM) BOLIVIA Santa Rosa, as *serratifolia, O Kuntze in 1892* (F, GH) La Paz Haciendo Simaco, sobre el camina a Tipuani, *Buchtien 832* (F, POM), *5508* (GH, NY, US); Pongo, Pulcheri, *White 232,* type no *filipes* (GH, US), Prov Larecaja · near Ananea. Machacamarca, *Mandon 624* (F, GH, NY), Prov No Yungas, between Unduavi and Chirca, *Eyerdam 25388* (F), Yungas, *Bang 675* (F, GH, NY, US), *Rusby 1812* (F, NY, US), *1813* type no. *boliviana, Brittoni* (NY, US). Cochabamba · prov Chapare, *Steinbach 9227* (GH); Incachaca, *Cárdenas 665* (US)

(53) **Fuchsia Osgoodii** Macbride

(Plate 9, fig. 49)

Fuchsia Osgoodii Macbride, Field Mus. Nat Hist, Botany, 13, part 4, no 1:559, 1941
F ovalis R. and P var. *aberrans* Macbride, l.c., 560

Shrub, up to 4 m tall, twigs dark, subglabrous, 1–2.5 mm. thick, leaves opposite, firm, elliptic-lanceolate, acute to acuminate at both ends, quite entire, deep green, glabrous above, paler and glabrous beneath except minutely puberulent or short-pilose on veins, with 10–12 principal lateral veins on each side of midrib, submarginal present; leaf-blades 5–8 (12) cm. long, 1.5–3 (6) cm wide, petioles glabrous, 8–10 mm long; flowers few, in short congested racemes; bracts 1–2 cm long; pedicels filiform, 1.5–2.5 cm. long, glabrous; ovary linear-ellipsoid, ca. 5 mm long; hypanthium 23–24 mm. long, dark red, somewhat enlarged at base, where 1.5.2 mm. wide, then 1 mm. wide for one-third its length, then gradually ampliate until 4–5 mm. wide at summit, glabrous without, villous within lower portion; sepals red, oblong-ovate, 10–11 mm long, 5–6 mm wide, glabrous, subulate for 1–1 5 mm. at apex, petals red, oblong, about 10 mm. long, 4 mm wide, abruptly acute, stamens 8 and 6 mm. long; anthers 1 6 mm long, style glabrous, equalling petals; stigma 4-lobed, 1 5 mm wide, berry oblong, at least 12 mm long and 4 mm wide

Type locality, PERU Dept Libertad Uchco, the type *Osgood and Anderson 47* (F) From Cajamarca · prov Cutervo Arenales, *Stork and Horton 10155* (F) comes the type of *ovalis* var *aberrans*, which has some lower and larger leaves than the type of *Osgoodii* They are more pilose on the veins beneath the leaves, but the upper smaller leaves have the same puberulence as in *Osgoodii* *F. Osgoodii* is near *F sanctae-rosae* in hypanthium, foliage, etc, but has more definitely terminal inflorescence

(54) **Fuchsia Andrei** Johnston

(Plate 9, fig 50)

Fuchsia Andrei JOHNSTON, Contr Gray Herb, 75 31, 1925.

Shrubby, the younger twigs more or less purplish red, fairly coarse, subglabrous except toward the minutely pubescent tips, 3–8 mm thick, leaves opposite or ternate, oblong-elliptic to elliptic-obovate, mostly obtuse at base, abruptly acuminate at apex, membranaceous, subentire, sparsely ciliolate, green and subglabrous above, paler beneath and puberulent on veins, with about 12 principal lateral veins on each side of midrib and with evident submarginal vein; blades 7–15 cm long, 3–7 (9) cm wide, petioles subglabrous, 1–2 5 cm long, stipules deltoid, ca 1 mm long, deciduous, inflorescence a short lateral or terminal raceme, bracts lanceolate, 3–10 mm long, somewhat pubescent, pedicels slender, somewhat pubescent, 10–15 mm long, ovary oblong, subglabrous, about 5 mm long, hypanthium 2–3 cm long, somewhat enlarged at base, then 1 mm wide for about one-third its length, then gradually ampliate until 4–4 5 mm wide at apex, subglabrous without, pilose within lower half, sepals oblong-lanceolate, 7–9 mm long, divergent, subulate for 1.5 mm at tips, almost glabrous, petals lance-oblong, 9–10 mm long, 2 5–3 mm wide, obtuse, stamens about 8 and 6 mm long, style pilose in basal half, exceeding sepals by 3–4 mm, stigma globose, 4-lobed, ca 1 mm thick, berry oblong, 6 mm. long and 3 mm wide

Type locality, Río de Huannamaca, probably southern Ecuador I have seen two collections. Río de Huannamaca, *André K820*, type no (F), Tambo de Savanilla, *André K 818* (F, GH, NY) The leaves are large and glabrous, the flowers in terminal racemes

(55) **Fuchsia Lehmannii** Munz, new species

(Plate 9, fig 51)

Soft-wooded shrub up to 2 m high, the younger twigs dark red, mostly glabrous, 1–3 mm thick, leaves opposite or ternate, elliptic-lanceolate or

-oblanceolate, acuminate or acute at both ends, rigid, subentire, glabrous, and dark green above, beneath paler and glabrous except for some short appressed pubescence on the reddish veins, the principal lateral veins 8–12 on each side of midrib; leaf-blades mostly 5–10 (12) cm long, 1 5–3 (4) cm. wide; petioles glabrous to somewhat strigulose, 5–15 mm. long, stipules lance-subulate, 1 mm or so long, deciduous, flowers numerous, crowded in short lateral and terminal racemes arranged paniculately; bracts lance-linear, reflexed, somewhat pubescent, 1–2 cm long; pedicels slender, pubescent, 8–18 mm long; ovary narrow-fusiform, more or less strigulose, 3–5 mm long, hypanthium red, 24–30 mm long, 1 mm. wide at base, then narrowed for one-third its length, then gradually ampliate until 3 5–5 mm wide at apex, mostly glabrous without and pubescent within the narrow basal portion, sepals scarlet, reflexed-spreading, linear-lanceolate, glabrous, 9–10 mm long, 2 5–3 mm. wide, subulate for 1–2 mm at apex, petals scarlet, oblong-lanceolate, about 1 cm long, 2–2 5 mm wide, obtusish; stamens 7 and 5 5 mm long, anthers 1 mm long; style glabrous, slightly exceeding petals; stigma 1–1 5 mm wide, fruit ellipsoid, 5–6 mm. long, 3–4 mm. wide

Frutex, 1–2 m. altus; ramulis rubris, subglabris, 1–3 mm crassis, foliis oppositis vel ternatis, elliptico-lanceolatis vel -oblanceolatis, acuminatis vel acutis, rigidis, subintegris, in superficie superiore glabris, inferiore glabris vel in venis puberulentis, laminis 5–10 (12) cm longis, 1 5–3 (4) cm latis, petiolis glabris vel substrigulosis, 5–15 mm. longis, floribus numerosis, in racemis paniculatis, bracteis lanceo linearibus, reflexis, pubescentibus, 1–2 cm longis, pedicelis tenuibus, pubescentibus, 8–18 mm longis, ovario angusto fusiforme, strigulosо, 3–5 mm longo, hypanthio rubro, 24–30 mm longo, base 1 mm lato, inde angustiore, inde ampliato et apice 3 5–5 mm. lato, externe subglabro, interne pubescente; sepalis coccineis, reflexo divergentibus, lineare lanceolatis, glabris, 9–10 mm longis, cum apicibus subulatis 1 5–2 mm. longis, petalis coccineis, oblongo-lanceolatis, 1 cm. longis, 2–2 5 mm latis, obtusis; staminibus 7 et 5.5 mm. longis, antheris 1 mm. longis, stylo glabro, petala excedentibus, stigmate 1–1.5 mm. lato, bacca ellipsoidea, 5–6 mm longa, 3–4 mm. lata

Type. from **Loja, Ecuador: east Andes of Sigsig, 1600–1800 m**, *Lehmann 5498* (equal Pearce's 235), type Field Museum 550994; isotypes GH, US A second collection also from Loja · Río Savanilla, east Andes of Loja, 800–1300 m, *Lehmann 7858* (F, US). The proposed species is near *F Osgoodii* in leaves and flowers, but sepals are more narrow and berry shorter; near *F. Hartwegii* in flower-shape, but glabrous and with more pointed leaves; near *F. Andrei*, but with glabrous style and narrow leaves

(56) **Fuchsia putumayensis** Munz, new species

(Plate 8, fig. 52)

Shrub or tree, younger twigs quite glabrous, with some purplish red about the nodes, 2–4 mm thick; leaves opposite, lance-ovate, rather membranaceous, acute to obtuse at base, acute to acuminate at apex, subentire, bright green and glabrous above, lighter and glabrous beneath except for fine appressed puberulence along midrib and veins, the principal lateral veins about 15, rather prominent beneath, the submarginal inconspicuous; blades 6–10 cm long, 2.5–4 cm wide, petioles 5–12 mm long, purplish red, somewhat strigulose, stipules not seen; flowers several, in very short compact terminal and lateral almost glabrous racemes, bracts reflexed, linear-lanceolate, 3–10 mm. long; pedicels filiform, quite glabrous, 1–2.5 cm long, ovary linear-fusiform, glabrous, 3.5–4 mm long, red; hypanthium bright red, 14–20 mm long, ca. 1 mm wide at base, then somewhat narrowed for one-third its length, then gradually ampliate until 2.5–3.5 *mm* wide at summit, glabrous without, pilose within lower portion; sepals scarlet, divergent, 7–9 mm. long, 3 mm. wide at base, subulate at apex for 1–1.5 mm., glabrous; petals scarlet, oblong, 6 mm long, about 3 mm. wide, rounded-obtuse at apex; stamens 5 and 3.5 mm. long, style glabrous, barely equalling petals; stigma ca 1 mm thick, fruit oblong-ellipsoid, about 2.5 cm long.

Frutex vel arbor, ramulis glabris, subrubris, 2–4 mm. diametro; foliis oppositis, lanceolato ovatis, membranaceis, basi acutis vel obtusis, apice acutis vel acuminatis, subintegris, in superficie superiore glabris, inferiore in venis strigulosis, laminis 6–10 cm. longis, 2.5–4 cm latis, petiolis 5–12 mm. longis, substrigulosis; racemis brevibus, compactis, terminalibus et lateralibus, subglabris, bracteis reflexis, lineari-lanceolatis, 3–10 mm longis, pedicellis glabris, 1–2.5 cm. longis, ovario lineare fusiforme, glabro, 3.5–4 mm longo, rubro, hypanthio rubro, 14–20 mm. *longo, basi 1 mm. lato, inde angustiore, inde ampliato et apice* 2.5–3.5 mm lato, externe glabro, interne piloso, sepalis coccineis, divergentibus, 7–9 mm longis, basi 1 mm latis, glabris, petalis coccineis, oblongis, 6 mm longis, 3 mm. latis, apice rotundatis vel subobtusis; staminibus 5 et 3.5 mm latis, style glabro, petala non excedentibus; stigmate 1 mm diametro, bacca oblongo-ellipsoidea, circa 25 mm longa

Type. **Comissaría del Putumayo: Cocoa, Colombia,** May 23, 1935, *H García B 4639,* U S Nat Herb 1593482 This is rather a fragmentary specimen and had almost finished flowering, so that the last late flowers may be somewhat small for the species A second specimen, Plañada de Minchoy, *Cuatrecasas 11436* (US) It seems near *F. Lehmannii* in having lateral and terminal compact racemes, being glabrous, having subulate sepal-tips and glabrous style. But it has more veins, too long a berry, too long pedicels and too short a hypanthium.

(57) **Fuchsia Hartwegii** Bentham

(Plate 9, fig. 53)

Fuchsia Hartwegii Bentham, Pl. Hartw., 179, 1845

Shrub or small tree, the younger branches slender, more or less purplish-red, pubescent, sometimes also with some longer hairs; leaves in 3's or 4's, elliptic-oblong, rounded to obtuse at base, obtuse to abruptly acuminate at apex, subentire or inconspicuously and remotely denticulate, membranaceous, darker green and appressed-pilose above, paler and pilose beneath especially on veins, principal lateral veins 14–16 on each side of midrib, submarginal vein present; leaf-blades mostly 4–10 cm. long, 2–4 (5.5) cm wide, petioles appressed-pilose, slender, 5–35 mm. long, stipules subulate-deltoid, 1.5 mm long, deciduous, flowers numerous in terminal pyramidal leafy-bracted, pendulous panicle 5–15 cm. long; bracts broadly elliptic, 8–25 mm long;

pedicels slender, pilose, 5–10 mm. long; ovary ovoid, appressed-pubescent, about 3 mm. long, hypanthium red, tubular, sparsely pubescent without, pilose within lower half, 1.4–2 cm. long, 1.5 mm. wide at base, then somewhat narrowed, then gradually widened until 4–5 mm. wide at apex; sepals orange-red or scarlet, linear-lanceolate, spreading-divaricate, 8–9 mm. long, barely 2 mm. wide, acuminate, with subulate tips less than 1 mm. long, pubescent on backs, petals red, linear-lanceolate, 8–9 mm. long, 2 mm. wide, acute, glabrous, stamens 10 and 8 mm. long, anthers 1.5–2 mm. long, style slender, glabrous or somewhat pubescent in lower part, equalling or exceeding sepals by 3–4 mm., stigma globose, about 1 mm. broad; fruit round-ellipsoid, up to 7 mm. long.

Type locality, Colombia: "In sylvis prope Pitayo et Huambia." A species of southern Colombia, where it grows at between 2000 and 3000 m., it seems near *F. Lehmannii*, *F. ovalis*, etc., in its general features: terminal inflorescence, short hypanthium, etc., but has its own characteristic pubescence, leaf-size, pedicel-length, and the like. Representative material is as follows, COLOMBIA. Caldas. *Dawe 741* (NY, US). Huila. "Balsillas" in Río Balsillas, *Rusby and Pennell 789* (NY, US). El Cauca: near Pitayo and Huambia, *Hartweg 994*, type no. (fragment F), (photo Berlin specimen F, POM), central Andes of Popayán, *Lehmann 5613* (F), Coconuco, *Killip 6829* (GH, NY, US); near Puracé, *Lehmann 3503* (F, US), San Isidro, Puracé, *Pennell and Killip 6460* (GH); Canaan, Mt. Puracé, *Pennell and Killip 6502* (GH), del páramo a Puracé, matorrales en Chiquín, *Pérez Arbeláez and Cuatrecasas 5973* (US).

(58) **Fuchsia ovalis** Ruiz and Pavón

(Plate 10, fig. 54)

Fuchsia ovalis Ruiz and Pavón, Fl. Peruv., 3: 87, pl. 324, fig. a, 1802.

F. polyanthella Johnston, Contr. Gray Herb., 75: 36, 1925. I have seen type material of both this and *ovalis*.

Erect or somewhat scandent, semishrubby, up to 1 m. tall, rather sparsely branched, the younger branches 3–6 mm. thick, more or less dark, pilose to almost glabrous, leaves opposite or ternate, membranaceous, broadly elliptic to oblong-ovate or obovate, obtuse to acute at base, abruptly acuminate at apex, entire to inconspicuously denticulate, darker green and hirsute-strigose above, paler and hirsute beneath especially on veins, with about 15–17 principal lateral veins on each side of midrib and with submarginal vein; blades mostly 8–15 cm. long, 5–8 cm. wide; petioles pilose, 2–5 cm. long, stipules subulate-deltoid, 2–5 mm. long, quite persistent; flowers in mostly axillary racemes up to 1 dm. long, bracts lanceolate, 1–1.5 cm. long, pilose; pedicels 1–1.5 cm. long, glabrous to pilose; ovary ellipsoid, 5–7 mm. long, glabrous to sparingly pilose, hypanthium 13–15 mm. long, scarlet, 1.5–2 mm. wide at base, then narrower until gradually widened to summit where 3.5–4.5 mm. wide, glabrous to sparingly pilose without, villous within lower half; sepals lanceolate, acute, somewhat divergent, 9–11 mm. long, acute, not subulate, glabrous to somewhat pilose; petals obovate-oblong, obtusish, 7–8 mm. long, stamens 5 and 4 mm long, filaments violet, anthers 1 mm. long, style glabrous, extending to sepal-tips, stigma subglobose, about 1 mm. broad; berry oblong, red-purple, somewhat 4-angled, about 1 cm long, 4 mm wide

Type locality, Muña, Huánuco, Peru The species is characterized by its large leaves which are pilose on both surfaces, by its lateral racemes, lanceolate bracts, and hypanthium 15 mm long I have seen the following collections, PERU · the *Ruiz and Pavón* collection from Madrid Herb (F), from Geneva Herb (photo F, POM) Húanuco Huallaga und Muña, 2800–2900 m., *Weberbauer 6721* (F); Muña, trail to Tambo de Vaca, 2600 m, *Macbride 4290,* type number polyanthella (F, GH)

(59) **Fuchsia asperifolia** Krause

Fuchsia asperifolia KRAUSE, Fedde Rep Nov Sp, 1 169, 1905

Low shrub, up to 5 dm tall, simple or few-branched, the young twigs dark, densely pilose, leaves opposite or ternate, membranaceous, broadly elliptic to elliptic-obovate, acute at both ends, subentire, hirsute on both surfaces, especially on veins beneath, with about 15 principal lateral veins on each side of midrib, submarginal vein present, blades 4–10 cm long, 2–5 cm wide, petioles hirsute, 2–5 cm long; stipules subulate, deciduous, flowers in dense usually terminal hirsute raceme, bracts apparently lanceolate, pedicels apparently scarcely 5 mm long, ovary about 6 mm long, pilose; hypanthium dark red, 2–2 5 cm long, slightly bulbous at base, then narrowed and gradually widened until 5–6 mm wide at apex, hirsute without, pilose within, sepals ovate, acuminate, 7–8 mm long, petals scarlet, narrowly obovate, acutish at apex, 8–9 mm long, stamens included, style equaling sepals, stigma subglobose, 4-lobed, fruit not seen

Type locality, Peru Amazonas between Tambos Bagazán and Almirante, east of Chachapoyas, at 2700 m; type *Weberbauer 4445* at Berlin (photo F, POM) Having seen only a photograph, I do not have many details, the species seems near to *F ovalis,* but with more terminal inflorescence, is more hirsute throughout and with shorter pedicels

(60) **Fuchsia pilosa** Fielding and Gardner

Fuchsia pilosa FIELD and GARDNER, Sert Pl, 1, pl 27, 1844, MACBRIDE, Field Mus Nat Hist., Bot 13, pt. 4, no 1 561, 1941.

Shrub, thinly white-pilose on young branches, leaves, petioles, hypanthia, etc, leaves ternate, oblong-lanceolate, acute at base, acuminate at apex, minutely denticulate, the blades 6–9 cm long, 1 8–2 cm wide, one of each whorl somewhat larger than the other two, two of petioles at each node 5–7 mm long, the third at least 2 cm long, flowers in terminal racemes which become 1 or more dm long, bracts like reduced leaves and 1–2 5 cm long, pedicels a few mm long; flowers scarlet, crowded, hypanthium apparently about 22 mm long; sepals oblong, 8–9 mm long, prominently subulate at apex, petals obtuse, wider than sepals, almost equaling them; style included; fruit oblong, 4-angled, less than 1 cm long

Type locality, Taulia, Amazonas, Peru. type *Mathews 1482,* which I have not seen Macbride separates this species on the basis of its unequal petioles and leaves, one at each node being larger than the other two It would seem from the description to be near to *F asperifolia* and the two are perhaps distinct from each other because of the unequal leaves

(61) **Fuchsia glaberrima** Johnston

(Plate 10, fig 55)

Fuchsia glaberrima Johnston, Contr Gray Herb, 75 32, 1925

Shrub, younger twigs slightly reddish, 3–5 mm thick, not branched, glabrous except for very minute scarce appressed-puberulence near tips, leaves opposite, firm, elliptic-oblanceolate, tinged reddish purple, obtuse at base, acuminate to acute at apex, entire, quite glabrous, with 13–15 principal lateral veins on each side of the midrib and with inconspicuous marginal vein, blades 10–20 cm long, 4–8 cm wide; petioles up to 5 (8) mm long, stipules connate, often reflexed, quite persistent, 2–2 5 mm long, inflorescence a short terminal raceme, bracts lanceolate, 1–3 5 cm long, pedicels stout, 5–7 mm long, minutely appressed puberulent; ovary fusiform, 6–9 mm long, hypanthium bright red, 2 5–3 cm long, about 2 mm wide at base, then very little contracted, then widened until 6–7 mm. wide at apex, almost glabrous without, densely pubescent throughout within, sepals scarlet, oblong, 9–11 mm long, 4–5 mm wide, obtusish; petals scarlet, broadly obovate, 9 mm long, rounded at apex, stamens 5 and 3 5 mm long, anthers 1 5 mm long; style densely pubescent much of its length, almost equaling sepals, stigma 4-lobed, 2 5 mm thick, fruit not seen

Type, ECUADOR Prov Tungurahua Valley of Pastaza River, between Baños and Cashurco, 1300–1800 m, type number *Hitchcock 21750* (GH, NY, US) Diels, Bibl Bot 116 119, 1937, refers here a Raimondi collection from Amazonas, Peru This species is like *F spectabilis* in its broad petals, but has a shorter hypanthium, like *F asperifolia* in general appearance, but more glabrous and with more sessile leaves

(62) **Fuchsia macrophylla** Johnston

(Plate 10, fig. 56)

Fuchsia macrophylla Johnston, Contr. Gray. Herb., 75.35, 1925

Shrub up to 3 m. tall, openly branched, the younger twigs 3–6 mm thick, with some dark red or purplish tinge, subglabrous to finely strigulose-puberulent toward the tips; leaves opposite, thick-membranaceous, elliptic, gradually attenuate and subacuminate at base, somewhat abruptly acuminate at apex, subentire, dark green above, paler beneath, subglabrous on both surfaces except for some minute puberulence along the veins, principal lateral veins

14–18 on each side of midrib, submarginal well developed; blades 7–15 (18) cm long, 3–5 (6.5) cm wide, petioles 1–4 cm long, stipules dark, lance-subulate, 1.5–2 mm long, deciduous, inflorescence mostly of short axillary sometimes terminal racemes, often only a few cm long and with few flowers; bracts lanceolate or wider, 5–15 mm. long; pedicels slender, minutely strigulose, 5–20 mm long, ovary ellipsoid, 4–5 mm long, hypanthium scarlet, 18–23 mm long, 1.5–2 mm wide at base, then narrowed, then gradually ampliate until 4–5 mm wide at apex, finely appressed-puberulent without, pilose within, sepals divergent, oblong-lanceolate, red with green tips, 7–8 mm long, 3 mm wide, appressed-puberulent on backs, apices subulate for 0.5 mm; petals bright red, oblong-oblanceolate, 8–9 mm long, somewhat mucronate at apex, stamens 6–8 and 3–5 mm long, anthers 1.5 mm long, style pubescent near base, scarcely extending to sepal tips, stigma 4-lobed, 1.5 mm thick, fruit dark red, subglobose to somewhat elongate, 8–10 mm long

Type locality, Hacienda Schunke, La Merced, Dept Junín, Peru This species is near *F Andrei* in leaf-size, puberulence, etc, but has more narrow and attenuate-based leaves, longer fruit, and more southern range I have seen, from PERU Húanuco Distrito Churubamba, trail Puente to Exito, Pampa Hermosa, 1750 m, *Mexia 8142* (F, GH, NY, US) Junín La Merced, *Macbride 5616,* type no (F, GH, US), Pichis Trail, 1600 m, *Killip and Smith 25436* (F, GH, NY), Eneñas, *Killip and Smith 25784* (GH, NY, US) Ayacucho Ccarrapa, between Huanta and Río Apurimac, 1500 m, *Killip and Smith 22353* (F, GH, NY), *22336* (NY, US) Cuzco Prov Paucartambo. Río Tambomayo, bet Tambomayo and Consuelo, 1100–1400 m, *West 7113* (GH)

(63) **Fuchsia sessilifolia** Bentham

(Plate 11, fig 57)

Fuchsia sessilifolia BENTHAM, Pl. Hartweg, 176, 1845

Slender, erect shrubs to small trees, the ultimate branchlets purplish red, 2–5 mm thick, glabrous except for the minutely strigulose-puberulent younger parts, leaves rather remote, in whorls of 3 or 4, elliptic-lanceolate to narrowly elliptic-ovate or -obovate, rounded to obtuse at base, acuminate at apex, remotely serrulate, rather coriaceous, glossy green and quite glabrous above, as well as minutely puberulent on the impressed veins, glabrous and paler beneath, or puberulent on the veins, principal lateral veins 15–20 on each side of midrib, submarginal vein evident; blades 8–15 cm long, 2.5–4 (5) cm wide, petioles 2–4 mm long, strigulose-puberulent, stipules subulate-deltoid, about 1 mm. long; inflorescence terminal, drooping, racemose-paniculate, 1–2 dm. long, canescent-strigose, conspicuously bracted, bracts mostly 1.5–2.5 cm long, ovate-elliptic; pedicels strigulose, slender, 3–5 mm long, ovary oblong, strigulose, 4–6 mm long, hypanthium scarlet, 13–16 mm. long, 1.5 mm wide at base, then very little narrowed, then gradually ampliate until 4–5 mm. wide at summit, finely strigulose-puberulent without, pilose within most of its length, sepals lanceolate, acuminate, divergent, greenish red, strigulose on backs, 8–10 mm long, subulate for almost 1 mm at tips, petals scarlet, oblong, 9–10 mm long, 3 mm wide, acutish, glabrous; stamens ca 7 and 5 mm. long; anthers 1 mm long, style glabrous, extending almost to ends of sepals, stigma about 1 mm thick; berry oblong, 10–12 mm long, 5–6 mm. thick, somewhat 4-angled

Type locality, "in sylvis Guayan in declivitate occidentali montis Pichincha," Ecuador The species seems to me to be near *F. Hartwegii* in inflorescence, hypanthium, etc, but differs in the long, subsessile, narrow, rather glabrous, firm leaves, short pedicels, conspicuous inflorescence It grows in southern Colombia and northern Ecuador at altitudes of from 2000–3600 meters Representative material is, COLOMBIA Antioquia Dauro, Choco, near Medellín, *Toro 1168* (NY). Caldas Buenavista-Quindio, *André in 1876* (F, GH, NY) Tolima Prov de Mariquita, El Gallego, *Triana 3813* (US), *Holton in 1853* (NY) Huila Cordillera Central, east of Neiva, *Rusby and Pennell 687* (NY, US), Cordillera Oriental, vertiente occidental, entre Gabinete y Andalucía, *Cuatrecasas 8586* (US) Cauca Valle de Quintero, near Pitaio, *Pittier 1427* (NY, US), Canaan, near Mt Puracé, *Pennell and Killip 6674* (GH, NY, US); Paletara to Calagualá, *Pennell 7111* (GH, NY, US) Nariño woods near Pasto, *Jameson 432* (US) Putumayo above El Encavo, Laguna La Cocha, *Balls 7521* (US) ECUADOR Carchi Canton Tulcan near Pun, *Mexia 7597* (POM, US) Pichincha · sive Andium Quitensium, *Jameson* under Couthouy (GH)

(64) **Fuchsia sylvatica** Bentham

(Plate 11, fig. 58)

Fuchsia sylvatica BENTHAM, Pl Hartweg, 176, 1845

F nigricans LINDEN, Fl de Serres, Sér 1, 5 pl 481, 1849, see discussion below

F atrorubra JOHNSTON, Contr Gray Herb, 75 31, 1925, I cannot maintain, although sepals and petals are somewhat short

Low shrub, more or less scandent, openly branched, the ultimate twigs purplish, minutely canescent strigulose, 2–4 mm. thick, leaves opposite to ternate, elliptic to elliptic-ovate or -obovate, obtuse to acute at both ends or subacuminate at apex (subentire or inconspicuously denticulate, membranaceous, deep green and strigulose above, paler and more densely strigulose beneath, veins reddish, the principal lateral ones 11–15 on each side of midrib, submarginal present, leaf-blades 3–10 cm. long, 1 5–5 (6) cm. wide, petioles strigulose, 6–20 mm long; stipules subulate-deltoid, 1–1 5 mm. long, somewhat persistent; flowers on terminal or lateral pendant strigulose racemes, bracts ovate to oblong to suborbicular, 1–2 5 cm long, pedicels slender, strigulose-canescent, 5–9 mm long, ovary narrowly ellipsoid, 4–6 mm long; hypanthium 14–19 mm long, ca. 1 5 mm thick at base, gradually ampliate until 2 5–3 mm wide at summit, more or less canescent-strigulose without, densely pilose within; sepals pink or pale red, divergent, linear-lanceolate, 6–9 mm long, acute, not subulate at apex, strigulose on backs; petals crimson to purple red, oblong, 7–9 mm long, acute, stamens 4–6 and 3–5 mm long, anthers 1–1 5 mm long, style glabrous, scarcely reaching sepal-tips; stigma 4-lobed, 2 mm wide, berry oblong, 12–14 mm long, 4 5–6 mm thick.

Type locality, "In sylvis Guayan in declivitate occidentali montis Pichincha," Ecuador It is near *F sessilifolia* in puberulence and short pedicels, but has broader leaves and more pubescent twigs. I have not seen the type of *F nigricans* from Mérida, Venezuela, but the three Jahn specimens seem to agree with the description Though these come from much farther north than the general range of *F sylvatica,* I cannot separate them unless I see the labels. Perhaps these Venezuela specimens have slightly looser pubescence and fruit about 2 mm longer Representative material of *sylvatica,* VENEZUELA Mérida · Páramo de Aricagua, 2500 m, *Jahn 1028* (US); between Boconó and Campo Elias, 2000 m, *Jahn 14* (US), selva arriba de Palmira, 2600 m, *Jahn 509* (US) COLOMBIA · Antioquia · Santa Elena, *Archer 1195* (US), Medellín, *Toro 972* (NY). Caldas Río Santa Rita, Salento, *Killip and Hazen 8966* (GH, NY, US), Salento, *Pennell and Hazen 10144* (GH, NY, US), Quindio, *Dawe 769* (NY, US), Santa Elena, above Santuario, *Pennell 10313,* type no *atrorubra* (GH, NY) Cundimarca · Fomeque, *Dawe 352* (US) Tolima · La Mediación, Quindio, *Triana 3511* (US), Río Toche to Machin, old Quindio Trail, *Killip and Hazen 9564* (GH) ECUADOR · Pichincha w slope Mt Pichincha, *Jameson 190* (GH), *Hartweg 984,* Geneva specimen US), between Cosanga and Baeza, 2000 m, *Mexia 7337* (US); Río Mapoto, (photo F, POM) Tungurahua Canton Quito Alaspongo, *Mexia 7703* (POM, *Penland and Summers 282* (F, POM)

Section 3 KIERSCHLEGERIA (Spach) Munz, new comb

Kierschlegeria, as genus, Spach, Nouv. Ann Sci nat, (2), 4 176, 1835, as subsect, Endlicher, Gen Pl, 1193, 1840

Pedicels axillary, pendulous, seeds angled Leaves sparse or subverticillate, thickened petiole-base persistent and becoming spine-like Sepals reflexed, little shorter than hypanthium

One species, *Fuchsia lycioides* Andr

(65) **Fuchsia lycioides** Andrews

(Plate 11, fig 59)

Fuchsia lycioides Andr, Bot. Rep, II, pl. 120, 1800, Bot Mag, 25 1024, 1807
F rosea Ruiz and Pavón, Fl Peruv., 3 88, 1802
F. spinosa Presl, Rel Haenk., 2 26, pl 51, 1835
F rosea var *spinosa* Reiche, Anal Univ Chile, 98 486, 1897, Fl de Chile, 2.268, 1898.

Shrub up to 3 m tall, the older branches stout, grayish, knobby with dwarf lateral branches, intricately branched and with some of the twigs dull-spinose at their ends, younger twigs more slender (2–3 mm thick), fairly straight, reddish, subglabrous with short sparse pubescence especially toward tips, beset after the leaves are shed by the persistent thickened woody bases of the petioles which form heavy dull spines 1.5–2 mm. long; leaves alternate, numerous, the blades lance-ovate to ovate, 6–24 mm. long, 3–15 mm. wide, subentire, acute to obtuse at both ends, glabrous except sometimes at tips and margins, somewhat paler beneath, petioles slender above the thickened base, glabrous to pubescent, 5–15 mm. long, stipules apparently fused with petiole base; flowers axillary, solitary, pedicels filiform, 5–8 mm. long, glabrous to puberulent, ovary rounded, 1.5–2 mm. long, hypanthium glabrous without and within, red, subcylindric, 4–7 mm. long, 2–2.5 mm. wide, sepals 4, red, lanceolate, acuminate, spreading-reflexed, glabrous or somewhat pubescent, 4–7 mm. long, petals purplish, obcordate, 3–4 mm. long, episepalous stamens about as long as petals, epipetalous somewhat shorter, style glabrous, reddish, about as long as sepals, stigma somewhat 4-lobed, about 1 mm. wide, berry blue-black, subspheric, 4–6 mm. thick.

Type locality given as "North-west coast of America," but undoubtedly Valparaiso, Chile, near which most specimens of the species have been collected. It apparently grows on dry slopes near the sea, mostly in the provinces of Coquimbo and Aconcagua. Representative material, CHILE: Fray Jorge, *Skottsberg 798* (NY), *Muñoz P. no. B-217* (GH), *Werdermann 1526* (B), *Berninger 621* (B), Punta de Teatinos, *West 3921* (GH), Coquimbo, *Gaudichaud 77* (B, G). Santiago: Santiago, *Germain in 1856–57* (G), Concon, *Poeppig 123* (B). Aconcagua: Valparaiso, *Macrae in 1825* (G), *Bertero 1006* (G, GH), *Gaudichaud 248* (F, G), *Rusby 1800* (F, NY, US), Laguna Verde, near Valparaiso, *Looser 2290* (POM), *Garaventa 1641* (GH), Choapa, near Los Vilos, *Mr. and Mrs. J. N. Rose 19280* (NY, US), Papudo, *Looser 2291* (POM).

SECTION 4. SKINNERA (Forst.) DeCandolle

Skinnera (FORST.) DC., Prodr., 3: 39, 1828; ENDLICHER, Gen. Pl., 1183, 1840; BENTH. and HOOK., Gen. Pl., 1, pt. 2: 791, 1862; RAIMANN in Engl. and Prantl, Die nat. Pflanzenfam., III, 7: 219, 1893.

as genus, FORST., Char. Gen., 57, pl. 29, 1776.

Hypanthium infundibuliform, swollen above ovary. Sepals reflexed. Petals small and scale-like or wanting. Filaments long, exserted. Fruit many-seeded, seeds very small, much crowded, in 2 or more rows. Stigma subcapitate, somewhat 4-lobed. Pedicels axillary, pendulous. Leaves alternate.

Type species, *Fuchsia excorticata* (Forst.) L. f.

KEY TO SPECIES OF SECTION SKINNERA

A. Petals 2–4 mm. long, plant very woody, varying from a liane to an erect shrub or tree, leaf blades whitish beneath, 1–9 cm. long.

  B. Trees, leaf blades 2–9 cm. long, with about 10 principal veins on each side of midrib.

    C. Leaves oblong-ovate to lance-ovate, acute to acuminate at apex, somewhat pilose beneath on midrib. New Zealand . . . . 66. *F. excorticata*

CC. Leaves elliptic to elliptic obovate, rounded to obtuse at apex, glabrous beneath Tahiti. . . . . 67 *F cyrtandroides*

BB Not trees, leaf blades 1–4 cm. long, with 3–9 main veins.

C Erect shrub; leaves oblong ovate, blades mostly 2–4 cm long 68 *F Colensoi.*

CC Liane, leaves suborbicular, blades mostly 1–2 cm long 69 *F perscandens.*

AA Petals lacking, plant small, procumbent, with very slender stems; leaf-blades less white beneath, 0 5–1.8 cm long

B Sepals acuminate, style about as long as stamens, hypanthium tubular-campanulate, 7–8 mm long . . 70 *F. procumbens.*

BB Sepals obtuse, style not exserted from hypanthium, hypanthium campanulate, 6–7 mm long. . . 71 *F Kirkii*

(66) **Fuchsia excorticata** (Forster) L f

(*Plate* 11, *fig* 60)

Skinnera excorticata FORST, Char Gen, 58, pl 29, 1776
Fuchsia excorticata (FORST) L f, Suppl, 217, 1781, LINDLEY, Bot Reg, 10 857, 1824

Wide-spreading tree 10 m tall, with papery exfoliating light brown bark, young twigs subglabrous to puberulent, subterete, more or less reddish in color, leaves alternate, oblong-ovate to lance-ovate, rounded to subcordate at base, acute to acuminate at apex, usually somewhat gland-denticulate, green and almost glabrous above, whitish and generally glabrous beneath except for some pilosity along veins and margins, blades 3–9 cm long, 1 5–3 cm. wide, with about 10 principal veins on each side of midrib and with submarginal vein, petioles puberulent, 1–1 5 (4) cm long, stipules ovate, acuminate, puberulent, less than 1 mm long, deciduous, flowers solitary, axillary, pendant, at first green, then purplish red, pedicels capillary, puberulent, 5–15 mm long, ovary subglabrous, 5–6 mm long, about 1 mm thick, hypanthium 4-angled, 8–15 mm long, subglabrous without and within, 2–5 mm wide at very base for 1–2 mm, then 1 5–2 mm wide and gradually ampliate until 4–10 mm wide at summit, sepals spreading to reflexed, ovate-lanceolate, glabrous, acuminate, 8–14 mm long; petals dark purple, erect, 2–4 mm long, elliptic, lanceolate, acutish, stamens erect, the episepalous 6–9 mm. long, the others somewhat shorter, anthers blue, 1–2 mm long, style glabrous, about equalling sepals, stigma subentire, 2 mm. long, yellowish, berry ellipsoid, about 1 cm. long, dark

Type locality not given, species ranging through New Zealand. Representative material, NEW ZEALAND. North Island · Auckland Waikowhai, *Miss Mackie in 1932* (NY); Auckland, *Petrie 4110, in 1898* (NY), *Meebold 9925* (NY). Wellington Feilding, *Allan in 1924* (NY), *in 1928* (CAS); Wainui-o-Mata, *Meebold 4619* (BISH), Khandallah, *Self in 1941* (POM, WELT) South Island. without definite locality, *Kirk* (F) Otago · Dunedin town-belt, Colby, *DN, from Herb D Petrie* (GH), cliff west of St Clair, *Prue Collier, per M Neal, 168* (BISH); Nelson, *Kirk 253* (GH), *Marie Neal 3* (BISH), Canterbury · Kaiturea Valley, Bank's Peninsula, *Cockayne 4111* (NY), So Canterbury, edge of forest on Hunter Hills, *Anderson 207* (F, NY).

(67) **Fuchsia cyrtandroides** Moore

(Plate 11, fig. 61)

Fuchsia cyrtandroides Moore, B P , Bishop Museum, Occasional Papers, 16.13, 1940

Tree up to 5 m tall, the young twigs quite glabrous; leaves mostly alternate, broadly elliptic to elliptic-obovate, green above, white beneath, glabrous, rounded to obtuse at base and apex, subentire to obscurely denticulate, with about 10 principal veins on each side of midrib and with indefinite submarginal vein; petioles 8–14 mm long, blades 2–9 cm. long, 2–5 5 cm wide, stipules apparently ovate, deciduous, flowers solitary, axillary, rose-magenta, pedicels 1.5–2 5 cm long, ovary fusiform-clavate, 6–7 mm long, 2 mm. thick, hypanthium about 1 cm long, tubular-campanulate, glabrous, 2–2 5 mm wide at base and gradually ampliate to 5–6 mm at summit, sepals spreading, lanceolate, subacuminate, 10–14 mm long, 4–5 mm wide, petals erect, oblong-ovate, 4 mm long?, stamens about as long as sepals, the epipetalous slightly shorter, style slightly exceeding stamens, glabrous, stigma 1 5 mm long, somewhat 4-lobed, berry black, ellipsoid, about 1 cm long

SOCIETY ISLANDS · Tahiti Orofena, south side, rain forest, 1500 m, May 14, 1927, *MacDaniels 1315,* type coll (BH, BISH), at 1600 m, *St John and Fosberg 17005* (BISH) The species is very near *F excorticata* in its arborescent habit, large leaves which are white beneath, and in the size and shape of the flowers It differs from that New Zealand species, however, in having the leaves proportionately wider, more obtuse and less pubescent.

(68) **Fuchsia Colensoi** Hook f

(Plate 12, fig 62)

Fuchsia Colensoi Hook. f, Handb. New Zealand Fl., 728, 1867; Trans. and Proc. New Zealand Inst, 1892 25, pl 19, fig 4, 5, 1893

Small branching erect shrub, with ultimate twigs very slender, puberulent, leaves oblong-ovate, rounded to subcordate at base, obtuse to subacuminate at apex, subentire, green and glabrous above except for fine strigulosity on impressed veins, white and glabrous beneath except for some pilosity on main veins, short-ciliate, principal lateral veins 6–9 on each side of midrib, petioles very slender, 5–10 (20) mm long; blades 1–4 cm long, 0.5–2 cm wide, pedicels filiform, 5–10 mm. long; ovary ellipsoid, about 5 mm long, 2–2 5 mm wide, hypanthium 8–10 mm. long, 2–2 5 mm wide at base, then 1–1 5 mm wide and rapidly ampliate until 5–7 mm, red, quite glabrous; sepals greenish to reddish, spreading-reflexed, lanceolate, 7–15 mm long, petals purple, 2–3 mm. long, stamens almost equaling sepals or about two-thirds as long, epipetalous; style exserted by 2–5 mm; stigma 1.5–2 mm wide; berry oblong, at least 8 mm. long

Type locality, North Island, New Zealand Material seen, NEW ZEALAND North Island: Papaitonga, in Kahikatea forest, *Oliver in 1941* (POM, WELT), Wammometa, Wellington, collector not given (WELT, photo

POM); Levin, Wellington, *Oliver in 1941* (POM, WELT) South Island. Kaikoura, *Kirk* (GH); Pelorus, *Kirk*, (F); Otago: Port Chalmers, *Petrie 4109* (NY) This species is very near to *F excorticata* and not surely distinct With inadequate material I am following what seems to be a tendency among New Zealand botanists, namely to recognize these several Fuchsia segregates as species

(69) **Fuchsia perscandens** Cockayne and Allan

(Plate 12, fig 63)

Fuchsia perscandens Cockayne and Allan, Trans Proc. N. Z Inst., 57 53, 1927

Climbing shrub, the main stems few-branched, the twigs appressed-puberulent, slender; leaves orbicular-ovate, subcordate at base, acute at apex, subentire to sinuate-denticulate, subglabrous above except for possible minute puberulence along the impressed midrib, whiter and subglabrous beneath, short-ciliate, with about 3–6 main veins on each side of midrib, blades 1–2.5 cm long, almost as wide, petioles almost filiform, 1–2 cm long, pedicels filiform, about 1 cm long; flower much as in *F Colensoi*, the hypanthium about 9 mm long, inflated at base, etc , sepals about 7 mm long; petals 2 5 mm long, berry dark purple, subcylindric, about 1 cm long, 5 mm thick

Type locality, "forests near Feilding," North Island, New Zealand Material seen, NEW ZEALAND North Island Palmerston North, *Zobro 3471* (CAS); Feilding, forest margin, *H H Allan, Aug 1924* (NY); Sinclair Head, Wellington Harb, *Healy 1* and *2* (POM, WELT) A second sheet from Feilding also at New York is an intergrade with *F. excorticata*, with longer and more oblong leaves which are pilose beneath on the veins, it may be a hybrid

(70) **Fuchsia procumbens** R Cunningham

(Plate 12, fig. 64)

Fuchsia procumbens R. Cunn., Ann Nat Hist., 3·31, 1839

F prostrata Baill, Bull. Soc. Linn, Par 1:270, 1880, *apparently a name for the above*

Procumbent, woody, with very slender glabrous stems, leaves alternate, not crowded, petioles very slender, channeled and pubescent above, 1 5–3 cm long, stipules minute, ovate, deciduous, blades suborbicular to round-ovate, subcordate at base, serrulate, subglabrous except on pubescent margin and veins of lower surface, somewhat paler beneath than above, 1–1 8 cm. long, sometimes somewhat wider, with about 5 principal veins on each side of midrib; flowers solitary, axillary, pedicels slender, subglabrous, scarcely 1 cm long, ovary 3–4 mm. long, fusiform-clavate, hypanthium apparently dark red, tubular-campanulate, 7–8 mm long, constricted above ovary, then abruptly dilated to about 3 mm wide, then more gradually until 5 mm. wide at summit, glabrous without and within; sepals reflexed, green, lance-deltoid, acuminate, 6 mm. long, 2 5 mm. wide, petals lacking; stamens slightly unequal, erect, ca 4 and 5 mm long, anthers 1 mm or slightly longer, style glabrous. about as long as stamens, purplish, stigma 1 5–2 mm thick, fruit not seen

Type locality, North Island, New Zealand, "around the village of Matauri on the east coast opposite the Cavallos Isles " Material seen, NEW ZEALAND. North Island, garden specimen, Khandallah, *Sutherland in 1941* (POM) South Island Canterbury Christchurch, Laing's Garden, *Meebold 25160* (BISH), Timaru, park gardens, *Anderson 35* (NY).

(71) **Fuchsia Kirkii** Hooker f

Fuchsia Kirkii Hook f ex T Kirk, Trans New Zealand Inst, 1 92, 1868, Icon Pl, 11 66, pl 1083, 1871

With prostrate habit and slender stems of *F procumbens;* petioles 1–1 5 cm long, blades 5–10 mm long, orbicular-cordate; pedicels ca 5 mm long, ovary ca 3 mm long, hypanthium campanulate, 6–7 mm long, 5–6 mm wide at summit, sepals reflexed, oblong, obtuse, 5 mm long, 2.5 mm wide, petals 0, stamens 3–4 mm long; style included in hypanthium, stigma less than 0 5 mm wide

Type locality, Great Barrier Island, New Zealand Specimens seen, NEW ZEALAND North Island · Tryphena Bay, *T Kirk* (F, GH), Port Tryphena, *Kirk 528* (GH) Apparently distinct from *F procumbens* in having a shorter wider hypanthium, sepals more oblong and obtuse, style shorter and stigma smaller

SECTION 5 HEMSLEYELLA Munz, new section

Nectary and hypanthium-base fused, petals lacking or nearly so Hypanthium funnelform to cylindro-funnelform, enlarged at base Sepals more or less connate at base Leaves tending to be deciduous at anthesis

Nectarium basem hypanthii adnatum, petalis fere nullis, hypanthio infundibuliforme vel cylindro infundibuliforme, base ampliato; sepalis base fere connatis

Type species, *Fuchsia apetala* Ruiz and Pavón This section is dedicated to W B Hemsley who published a paper on the apetalous Fuchsias of South America in the Journ of Bot 14:69–70, 1876

KEY TO SPECIES OF SECTION HEMSLEYELLA

A Hypanthium less than 2 cm long, leaves with 13–16 principal lateral veins on each side of midrib 83 *F cestroides.*
AA Hypanthium more than 2.5 cm long, leaves with 5–10 principal lateral veins on each side of midrib
  B Hypanthium at least 4–5 times as long as the sepals (including the connate base of the latter).
    C Leaves well developed at anthesis, petioles mostly 3–7 cm long, pedicels 3–5 cm. long, hypanthium 10–14 cm long . 81 *F Garleppiana*
    CC Leaves mostly deciduous at anthesis, petioles mostly 1–3 cm long, pedicels 0.5–2.5 cm long; hypanthium 6–12 cm. long. . . 82. *F macrantha.*
  BB Hypanthium usually 1.5–3 times as long as sepals (including connate base)
    C Hypanthium glabrous without
      D Leaves alternate, lance-ovate, the blades mostly 2.5–4 times as long as wide, hypanthium 8–12 mm. wide; sepals greenish 78. *F tuberosa.*

DD. Leaves mostly subopposite, elliptic- or oblong ovate, the blades not more than twice as long as wide, hypanthium 5–8 mm. wide, sepals red
  E Petals 2 mm long, sepals 8–12 mm long. Mexico. 72 *F decidua.*
  EE Petals none, sepals 18–22 mm. long South America.
    F Leaves largely deciduous at anthesis, stamens exceeding sepals, *style* 1–1.5 cm *longer than sepals Peru to Bolivia* 74. *F juntasensis.*
    FF Leaves well developed during anthesis, stamens shorter than sepals, style scarcely extending beyond sepals. Venezuela 75 *F membranacea*
CC Hypanthium not glabrous under a lens
  D Leaves lance ovate, twigs glabrous, hypanthium sparsely and finely glandular pubescent . 76 *F salicifolia*
  DD Leaves elliptic to oblong ovate, twigs not glabrous
    E Leaves subopposite; pubescence very fine, short, velvety, hypanthium 5–8 mm. wide Largely Bolivian. 77 *F tunariensis*
    EE Leaves alternate, pubescence longer, hypanthium 7–11 mm wide
      F Stamens longer than sepals, pedicels 1.5–2.5 cm long, inflorescence short pubescent Venezuela to northern Peru 78 *F apetala*
      FF Stamens shorter than sepals; pedicels 1–1.5 cm long, inflorescence shaggy pilose Central Peru to Bolivia
        G Leaves deciduous at anthesis, hairs white, 0.5–1 mm long 79 *F hirsuta*
        GG Leaves present at anthesis, hairs brown, 1–1.5 mm long 80 *F unduavensis*

(72) **Fuchsia decidua** Standley

(Plate 12, fig 65)

Fuchsia decidua Standley, Pub Field Mus Nat Hist, Bot 4 248, 1929

Shrub with long subterete or somewhat 4-angled branches, the younger ones 3–9 mm thick, brownish, glabrous, with internodes 1–3 cm long, leaves opposite, unknown, deciduous at time of flowering, inflorescence short racemose lateral panicles 2–6 cm long, with glabrous, somewhat glaucous very slender branches, pedicels slender, recurved, 3–8 mm long, hypanthium 2–3.5 cm long, almost 2 mm wide at base, then narrowed into an elongate tube which gradually flares upward until 5–6 mm wide at mouth, somewhat glaucous, light vermilion, glabrous without and within, sepals vermilion, oblong, obtuse, 8–12 mm long, 4 mm wide; petals suborbicular, 2 mm long, stamens about 9 and 6 mm. long; filaments thickish, anthers 1.5–1.8 mm long; style glabrous, about equal to sepals; stigma barely 1 mm long, berry not seen, but probably longer than thick

Type locality, MEXICO: Jalisco · Real Alto, La Bufa, Sierra Madre Occidental, at 2500 m ; *Mexia 1601* being the type no (F, GH, CAS, MICH, NY, US) A second collection of apparently the same thing comes from the state of Guerrero; Sierra Madre near Chilpanengo (Chilpancingo?), *Nelson 2195a* (US); none of the flowers is fully matured, hence shorter than in the type collection. Not knowing the leaves, I find it difficult to determine a close relationship for this species in the section *Eufuchsia*, but it seems to be near to the apetalous species of *Hemsleyella* in its greatly reduced petals Some of these species have also lateral reduced inflorescences.

(73) **Fuchsia tuberosa** Krause

Fuchsia tuberosa KRAUSE, Fedde Rep., 1.170, 1905

Shrub up to 1 m tall, epiphytic or terrestrial; roots bearing clusters of roundish tubers; stems few-branched, reddish, glabrous, the branchlets 2–5 mm thick; leaves may shed at time of flowering, alternate, lance-ovate to lanceolate or ovate, subglabrous, round or acute, sometimes cordate at base, curved-acuminate at apex, entire to denticulate, paler beneath than above, with 6–8 principal lateral veins on each side of midrib; blades 5–10 cm long, 2–3 5 cm wide, petioles slender, 1–2 (3) cm long; stipules deltoid, about 0 4 mm long, deciduous, flowers in upper axils, sometimes crowded terminally, pedicels slender, 2–6 cm long, glabrous or nearly so, ovary cylindric, glabrous, 8–12 mm long, 1–2 mm thick, hypanthium red, 3.5–8 cm long, 3–4 mm. wide at base, then narrowed to 1 5–2 mm for less than 1 cm, then abruptly widened to 8–12 mm. for the rest of its length, glabrous without, villous within at base, sepals green, erect-divergent, lance-deltoid, 12–20 mm. long, 5–8 mm. wide, acute, connate for one-fourth their length, petals 0; episepalous stamens about as long as sepals, alternate ones three-fourths as long, yellow, anthers 3–4 mm. long, yellow, style slender, pubescent near base, exserted beyond sepals for 1–5 cm, stigma elongate-capitate, 2–3 mm long, fruit glabrous, 2–2 3 cm. long

KEY TO VARIETIES OF *Fuchsia tuberosa*

A Hypanthium 3.5–5 cm long	73a. var *typica*.
AA Hypanthium 6–8 cm. long	73b var. *inflata*

(73a) **Fuchsia tuberosa** Krause, var **typica** Munz, new name

(Plate 12, fig 66)

Fuchsia tuberosa KRAUSE, Fedde Rep., 1.170, 1905
Fuchsia chloroloba JOHNSTON, Journ Arnold Arboretum, 20 243, 1939

Hypanthium 3 5–5 cm. long.

Type locality, between Sandia and Cuyocuyo, Puno, Peru, at 2700–2800 m, based on *Weberbauer 875* at Berlin (photo F, POM) Material seen, PERU: Dept Cuzco: "Pillahuata," Cerro de Cusilluyoc, 2200–2400 m., *Pennell 13973*, type no *chloroloba* (F, GH), Marcapata Valley, 1200 m, *Herrera 1166* (US), between Achirani and Medias-Mayu, 2700 m, *Vargas 11116* (F); Río Tambomayo, from Pillahuata bridge to head of Tambomayo Grade, 1600–2300 m, *West 7094* (GH); between Tanamayo and Tambomayo, 2000 m, *Vargas 70/7094* (F). The Krause description does not mention green sepals, as does Johnston's, but the region, the leaf- and flower-shape, glabrous hypanthium, etc, certainly make *tuberosa* and *chloroloba* the same.

(73b) Fuchsia tuberosa Krause var inflata (Schulze-Menz) Munz, new comb

Fuchsia inflata Schulze-Menz, Notizbl. Bot Gart, Berlin, 15 136, 1940

Hypanthium 6–8 cm long

Type from Cuzco prov Paucartambo, between the tambos Tres Cruces and Tambomayo, above Cosñipata, at 3100 m, April, 1914, *Weberbauer 6935* (F, GH, POM, US) This does not seem specifically distinct, and more material may show that it is not worth any recognition.

(74) **Fuchsia juntasensis** O Kuntze

(Plate 12, fig 67)

Fuchsia juntasensis O Kuntze, Rev Gen 3, part 2 97, 1898
F Mattoana Krause, Engl Jahrb, 37 599, 1906
F Steinbachii Johnston, Contr Gray Herb, 75 38, 1925

Vinelike, usually epiphytic shrub, 5 or more dm tall, few-branched, the younger twigs usually purplish, subglabrous or sparsely pubescent, the older ones with exfoliating outer tissues, leaves mostly subopposite, tending to fall during anthesis, the blades elliptic- to oblong-ovate, acute to obtuse at base, acuminate at apex ,subentire, 4–8 cm long, 1 5–3 5 cm wide, sparsely short-pubescent to glabrescent above and beneath, paler beneath than above, principal lateral veins 6–8 on each side of midrib, petioles sparsely pubescent, 5–12 mm long, ca 1 mm wide, stipules subulate, 1–1 5 mm long, caducous, flowers few, crowded in terminal racemose clusters, often on short lateral twigs, pedicels slender, subglabrous, 1 5–5 cm long, ovary oblong-fusiform, puberulent to subglabrous, 5–10 mm long, 2–2 5 mm wide, hypanthium rose to flesh-colored, tubular-funnelform, 2.5–4 5 cm long, 2–2 5 mm wide at base, then slightly narrowed for one-third its length, then gradually ampliate until 5–7 mm wide at summit, glabrous without, pilose within near base, sepals 4, reddish, ovate-lanceolate, 18–22 mm. long, 5–6 mm wide, glabrous, subacuminate, connate for 2–3 mm at base, petals none; episepalous stamens 20–26 mm long, alternate ones 16–20 mm long, anthers cream, 3–4 mm long, style pubescent in lower portion, extending 1–1 5 cm beyong the sepals, stigma green, oblong-globose, 2–3 mm long, scarcely lobed, berry ellipsoid, about 12 mm long

Type locality, east side of Cordillera, at 3000 m, between Cochabamba and Río Juntas, Bolivia I have not seen the type of *F juntasensis* so labeled and have had some misgiving about taking up this name for this concept, especially since Kuntze's description sounds as if the calyx were short, giving sepals as 12 mm long, and even if one adds 3–4 mm for the connate base, which Kuntze may well not have included as part of the sepals, the length is still rather inadequate But all other features. glabrous flowers, ovate, acuminate leaves, shape of hypanthium, would point to this concept. Of *F Mattoana* I have seen only the photograph; between it and *F Steinbachii* I can see no difference except the somewhat shorter hypanthium (25–28 mm) given by Krause

However, a series of specimens seems to break down the validity of this character. For the species which I am calling *F. juntasensis* I have seen the following collections: without locality: Herb. O. Kuntze (NY). PERU: between Cuzco and Santa Ana, 3400 m., *Weberbauer 4976*, type of *Mattoana* at Berlin (photo F, POM). BOLIVIA: Depto. Cochabamba: Incachara, 2500 m., *Steinbach 5038*, type *Steinbachii* (NY); Quebrada de Corani, prov. Chapare, 2400 m., *Steinbach 9862* (F, GH, NY). The species differs from *F. apetala* in its glabrous flowers and more southern range.

(75) **Fuchsia membranacea** Hemsley

Fuchsia membranacea Hemsley, Journ. Bot., 14: 70, 1876.

Shrub, glabrous throughout except ofr the minute pubescence on the upper surface of the young leaves which may persist along the veins; branches few, younger ones purplish, 2.5–3.5 mm. thick, older ones exfoliating; leaves subopposite, well developed at anthesis, the blades membranaceous, oblong-ovate, remotely denticulate, paler beneath, rounded at base, short-acuminate at apex, 3–5.5 cm. long, 1.5–3.5 cm. wide, with 6–7 principal lateral veins on each side of midrib; petioles puberulent, 6–15 mm. long, scarcely 1 mm. wide; stipules subulate-deltoid, about 0.5 mm. long; flowers axillary; pedicels slender, 2.5–4 cm. long; ovary oblong, 5–7 mm. long, 2 mm. thick; hypanthium tubular-funnelform, 4–5 cm. long, slightly enlarged and 2.5 mm. wide at base, then 1.5–2 mm. wide for about 1 cm., then gradually widened in upper half until 7–9 mm. broad, glabrous without, pubescent within near base; sepals divergent, ovate-lanceolate, 18–22 mm. long, 6–7 mm. wide, subacuminate, very little connate at base; petals 0; episepalous stamens 14–20 mm. long, alternate ones 9–15 mm. long; anthers 2–3 mm. ling; style pubescent in lower portion, scarcely extended beyond sepals; stigma oblong-capitate, 2–3 mm. long; berry short-ellipsoid, about 1 cm. long.

Type locality, Caracas, Venezuela, type based on *Linden 372*, of which number I have seen fragment (F) and photo (F, POM). Other material seen, VENEZUELA: state of Trujillo: Páramo de la Cristalina, 2900 m., *Jahn 12* (US). Mérida: Páramo de Timotes, 3000 m., *Jahn 508* (GH, US). Like *F. juntasensis*, the species has glabrous flowers, but it is leafy at anthesis and has shorter stamens.

(76) **Fuchsia salicifolia** Hemsley

Fuchsia salicifolia Hemsley, Journ. Bot., 14: 70, 1876.

Epiphytic shrub, mostly glabrous except about the flowers; branchlets few, purplish with persistent epidermis; leaves fully developed during anthesis, alternate, lanceolate, obtuse at base, long-acuminate at apex, remotely denticulate, thickish, with about 10 principal lateral veins on each side of midrib, the blades 6–10 cm. long, 2–2.6 cm. wide; petioles ca. 1 cm. long, 1.5 mm. wide; stipules not seen; flowers few, axillary; pedicels 2–2.5 cm. long, slender, pubescent, with some gland-tipped hairs, ovary linear-oblong, 1 cm long, 2–2 5 mm. wide; hypanthium tubular-funnelform, 4–5 5 cm long, sparsely glandular-pubescent without, 2 5 mm thick at base, then narrower for about 1 cm , then gradually widened to 7 mm ; sepals lanceolate, acuminate, spreading, ca 3 cm long, 1 cm. wide, connate at base for 2–3 mm ; petals 0, episepalous stamens about 27 mm long, alternate ones 20 mm. long; anthers 3–4 mm long, style exserted, stigma "clavate", berry about 2 cm long

Type locality, Sandillani, I am not sure whether this is in southern Peru or in Bolivia The only specimen I have seen which I can refer here is from Unduavi, North Yungas, Bolivia at 2450 m , *Rusby 1803* (NY), it is a specimen with 1 leaf and 1 flower The species seems distinct in its narrow leaf, subglabrous condition and long sepals In hypanthium-shape it seems near *F apetala*

(77) **Fuchsia tunariensis** O Kuntze

(Plate 13, fig 68)

Fuchsia tunariensis O KUNTZE, Rev Gen Pl, 3, part 2 98, 1898

Epiphytic or prostrate to scandent shrub with tuberous roots, stems up to 8 dm long, few-branched, the young growth pallid with densely velvet pubescence, twigs often knotty and irregular, purplish, densely pubescent, leaves largely subopposite, tending to be deciduous at anthesis, blades elliptic- to oblong-ovate, 4–15 cm long, 2–6 cm wide, membranaceous, densely fine-pubescent, velvety when young, entire, rounded to obtuse at base, subacuminate at apex, petioles 5–20 mm long, densely pubescent, about 1 mm wide, stipules subulate, gland-like, scarcely 1 mm long, deciduous, flowers few, solitary in uppermost axils, pedicels densely pubescent, 1–1 5 cm long, ovary densely short-pubescent, oblong, 5–8 mm long, hypanthium red to pinkish, tubular-funnelform, 4 5–5 5 cm long, densely short-pubescent without, pilose within lower portion, 2 5–3 mm wide at base, then 1 5–2 mm wide for about 1 5 cm , then gradually ampliate until 5–8 mm wide at mouth, sepals red, lance-ovate, acute, 18–22 mm long, connate for about 3 mm at base, petals 0, episepalous stamens 13–18 mm long, alternate ones 10–13 mm long, anthers about 3 mm long, style pilose at base, scarcely exserted or as much as 1 cm longer than sepals, stigma ca 2 mm long, subglobose, fruit hairy, ellipsoid, almost 2 cm long.

Type locality, "Tunarigebirge," Cochabamba, Bolivia, at 3000 m The type in Herb Otto Kuntze (NY) is badly broken, the solitary flower has pedicel, ovary and lower half of hypanthium, but the pubescence is very characteristic In fact, it is the close, fine, dense pubescence which distinguishes this species, of which I have seen the following representation PERU Cuzco, prov Paucartambo, below "Pillahuata," 2300 m , *West 7106* (GH) with rather large sepals, but typical pubescence BOLIVIA . Cochabamba Tunari, *Kuntze in 1892*, type (NY); Ayopaya, Sailapata, 3500 m , *Cárdenas 3393* (US), *3369* (US) Pongo, *Tate 188* (NY)

(78) **Fuchsia apetala** Ruiz and Pavón

(Plate 13, fig 69)

Fuchsia apetala Ruiz and Pavón, Fl. Peruv , 3 89, pl. 322, fig b, 1802

F insignis Hemsley, Journ Bot., 14.69, 1876; three collections were cited from Ecuador, 2 by Jameson and 1 by Spruce The last which cannot be taken as the type, is the only one I have seen, but I am unable to separate *insignis* from *apetala*

Vine-like shrub, often epiphytic, up to about 1 m. high, the younger branches reddish, more or less pubescent, with some gland-tipped hairs, rather coarse, commonly 3–5 mm. thick, with exfoliating epidermis and frequently with adventitious roots; leaves largely deciduous at anthesis, alternate, the blades elliptic-ovate, subentire, rounded to subcordate at base, acute to acuminate at apex, somewhat coriaceous, finely pubescent to glabrescent above, villous beneath, especially beneath on midrib and veins, principal lateral veins 6–8 on each side of midrib, leaf-blades 5–9 cm long, 3–4 5 cm wide, petioles 1 5–2 5 cm long, somewhat villous, 1 5–2 mm wide, stipules subulate, 1 5–2 mm long, caducous, flowers few, crowded near apex of branchlets, pedicels slender, 1 5–2 5 cm long, villous, with some gland-tipped hairs, ovary cylindrical, 8–15 mm. long, villous, 2–4 mm thick, hypanthium orange-scarlet, 4–5 5 cm long, tubular-funnelform, 3–5 mm wide at bulbous base, then abruptly narrowed to 1 5–3 mm for about 1 cm, then gradually ampliate until 7–11 mm wide, sparsely glandular-villous without, villous within lower portion, sepals reddish-orange, more or less spreading, lance-ovate, 22–25 mm long, 8–10 mm wide, acute to obtusish, pubescent without, connate for 2–3 mm at base, petals 0, episepalous stamens 25–30 mm long, alternate 18–20 mm long, anthers green, 3–4 mm long, style pubescent at base, exserted 1–2 cm beyond the sepals; stigma subglobose, 2–3 mm long, usually scarcely lobed, fruit oblong, red

Type locality "Habitat copiose in Huassahuassi et Muña," Peru At Field Museum are fragments of what I here consider to be *apetala* mixed with *F macrantha* Hook , collected by Ruiz and Pavón; my judgment as to which is to be taken as *apetala* is based on the plate by Ruiz and Pavón I prefer, since this Ruiz and Pavón material in its present condition contains both entities and since I believe these are separable on the basis of geographical and morphological characters, to keep the name *apetala* for the Ruiz and Pavón plant that was illustrated, rather than to treat all as one thing as does Macbride (Field Mus. Nat Hist, Bot 13 part 4, no 1.546, 1941) I would refer the following material to *apetala*, VENEZUELA Mérida. Páramo de Aricgua, 2000 m., *Jahn 1030* (US); Páramo de San José, 2400 m, *Jahn 969* (US), Páramo de Mucuchachí, 1800 m, *Jahn 981* (US) ECUADOR· between Cuenca and Huigra, Chimborazo, 2700–3000 m, *Hitchcock 21701* (GH, NY, US); Huigra, *Rose and Rose 22230* (GH,'NY, US); Mt Azuay, *Spruce 5976* (GH, NY, photo of Geneva specimen at F, POM) PERU?: Churupullana, *Dombey* ex Herb Mus Paris (F) I can see no difference between the Venezuela and Ecuador specimens in spite of the discontinuous distribution.

(79) **Fuchsia hirsuta** Hemsley

(Plate 13, fig 70)

Fuchsia hirsuta HEMSLEY, Journ Bot , 14 69, 1876

Tuber-bearing, climbing, epiphytic shrub or scandent over faces of cliffs, few-branched, mostly leafless at anthesis, the younger twigs 3–8 mm thick, knotty, tortuose, densely pilose with white hairs not over 1 mm long, more or less purplish underneath the hairs, leaves alternate, ovate to oblong-ovate, membranous, subentire to denticulate, rounded at base, acute to almost acuminate at apex, densely pilose on both surfaces when young, more or less glabrescent except for veins of under surface, principal lateral veins 5–8 on each side of midrib, leaf-blades 6–12 cm long, 3 5–6 cm wide, petioles pilose, 1–4 cm long, 1 5–2 mm wide, stipules pilose, lanceolate, ca 1 mm long, flowers few to many, crowded near tips especially of lateral twigs, pedicels slender, pilose, 1–1 5 cm long, ovary cylindric, densely shaggy-pilose and pubescent, 8–12 mm long, 1 5–2 5 mm thick, hypanthium tubular-funnelform, densely pilose and pubescent, with some hairs gland-tipped, fiery to purplish red, 3–5 5 cm long, 2–3 mm thick at base, then slightly narrowed for one-third its length and then rather abruptly widened into the cylindrical upper part which is 8–10 mm wide, pilose within the lower portion, sepals reddish, ovate to lance-ovate, obtuse to acute, pilose on backs, 15–20 mm long, 7–10 mm wide, connate only a short distance at base, petals 0, episepalous stamens 15–18 mm long, alternate ones two-thirds as long, anthers about 3 mm long, style pilose above the base, extending to as much as 1 5 cm beyond the sepals, stigma about 2 mm long, berry narrowly ellipsoid, almost 2 cm long

Type locality, "Peruvia", I have not seen the type, *Lechler 1989* The species is included in *F apetala* by Macbride (Field Mus Nat Hist , Bot , 13, part 4, no 1 546, 1941), but to me it is a more southern entity with short sepals and more included stamens, gray-pilose and shaggy ovaries and hypanthia I have seen from PERU Ayacucho Punaccuanca Pass, 4100 m , *West 3669* (GH) Cuzco prov Paucartambo, disto Marcachea, forest of Pucará, 3400 m , *Vargas 11170* (F), below Tres Cruces, *Weberbauer 6975* (F, GH) , prov Urubamba, disto Chincheros, Chincheros, 3700 m , *Vargas 9602* (F) , Yucay, 3000 m , *Soukup 715* (F) , Cuzco, 2500 m , *Herrera 2189* (GH) , Saxaihuaman, *Herrera 2189* (F) , Combapata, Canchis, 3700 m , *Vargas 1900* (GH) Puno, *Soukup 525* (F) BOLIVIA La Paz Ingenio, between Sorată and Mapiri, 3700 m , *Cárdenas 1142* (NY) , La Paz prov Larecaja, near Sorată, ***Mandon 629*** (F, GH) , Pongo, *White 248* (GH, US)

(80) **Fuchsia unduavensis** Munz, new species

(Plate 13, fig 71)

Much like *F. hirsuta,* but with leaves well developed at time of flowering, blades elliptic-ovate, 7–10 cm, long, 2–5 cm wide, with 6–7 principal lateral veins on each side of midrib, young stems, ovaries, pedicels, hypanthia with spreading, brownish hairs about 1.5 mm. long, hypanthium 4.5–5 5 cm long, 7–8 mm wide in upper part, sepals 2 cm long, lance-ovate, acute to obtusish

F. hirsutae similis, foliis ad anthesin praesentibus, elliptico ovatis, laminis 7–10 cm longis, 2–5 cm. latis, caulibus junioribus, ovariis, pedicellis, hypanthiis capillis fuscis et 1.5 mm. longis vestitis, hypanthio 4 5–5.5 cm. longo, supra 7–8 mm. lato; sepalis 2 cm. longis, lanceolato ovatis, acutis vel subobtusis

Type: **Unduavi, North Yungas, Bolivia, at 3600 m.**, Feb 13, 1907, *Buchtien 2925,* United States Nat Herb 1177335 Other collections from same place at 3200 m, Nov, 1910, *Buchtien* (F), at 3600 m., Nov, 1910, *Buchtien 2925* (US)

(81) **Fuchsia Garleppiana** Kuntze and Wittmack

(Plate 14, fig 72)

Fuchsia Garleppiana KUNTZE and WITTM, Gartenfl, 47 461, fig 96, 1898

Tuberous, the thickened roots said to be 20–90 cm long, slender-stemmed, few-branched, up to 1 m high, epiphytic or on wet slopes, the ultimate branchlets reddish, soft-pubescent, 2–4 mm thick, tardily exfoliating, leaves alternate, well developed at anthesis, ovate to oblong-ovate, the blades thin, rounded to subcordate at base, subacuminate at apex, subentire to remotely denticulate, finely pubescent above and beneath, with 8–9 principal veins on each side of midrib, blades 6–10 cm long, 4–6 cm. wide, petioles pubescent, 2 5–7 cm long, about 1 mm wide, stipules lanceolate, scarcely 1 mm long, deciduous, flowers in axils on main growing branches, pedicels slender, soft-pubescent, 3–5 cm long, ovary 5–10 mm long at anthesis, soft-pubescent, 2–3 mm thick; hypanthium 10–14 cm long, subcylindric, finely pubescent without and within, pink, 5–6 mm thick at base, then narrowed to 2–3 mm and then gradually wider until 8–10 mm broad below the somewhat contracted mouth, sepals pink, lance-ovate, acute, somewhat divergent, 13–18 mm. long, 5–7 mm wide, connate almost one-half their length, fine-pubescent on both surfaces; petals 0; episepalous stamens about three-fourths, alternate ones about two-thirds the sepals, anthers 2 5–3 5 mm. long; style pubescent near the base, slender, scarcely extending beyond the sepals, stigma subglobose, 2–3 mm thick; fruit not seen.

Type locality, Cocapata, Cochabamba, Bolivia, at 3000 m in the Tunari Mts The species is near to *F. macrantha* in its long hypanthium, but differs in many respects · flowers not on spur-like branchlets, plant leafy at anthesis, petioles longer and more slender, pubescence finer and shorter, sepals hairy on both surfaces, filaments pubescent; hypanthium narrowed at end Material seen, PERU Dépt du Cuzco, Aout, 1847, *Weddell,* from Herb Mus Paris (F). BOLIVIA. Cochabamba · Incachaca, 2700 m, *Cárdenas 688* (US); Incacorral-Aduana, Chapare, 2700 m, *Steinbach 9538* (GH, NY); Tunarigebirge, 3000 m., Herbarium *Otto Kuntze,* type coll (F)

(82) **Fuchsia macrantha** Hooker

(Plate 14, fig. 73)

Fuchsia macrantha Hook , Bot Mag , 72 pl 4233, 1846

Low, trailing or straggling, or epiphytic, few-branched, the twigs 2.5–6 mm. thick, pubescent to villous, with some hairs gland-tipped, freely exfoliating, leaves largely lacking at anthesis, alternate, elliptic-ovate, acute, subentire, rounded or subcordate at base, pubescent above, pilose beneath especially on veins and when young, with 6–7 principal lateral veins on each side of midrib, blades 4–9 cm long, 3–6 cm wide, petioles 1–2 (3 5) cm long, more or less pilose, 1–2 mm wide, stipules lance-deltoid, 0 5 mm long, deciduous; flowers crowded on short branchlets, pedicels slender, pubescent, 1–2 cm long, ovary linear, pubescent, 6–12 mm long, 1 5–3 5 mm thick, hypanthium rose-red. to coral or scarlet, subcylindric to cylindro-fusiform, 6–12 cm long, 3–8 mm wide at base, then narrower and very gradually ampliate until 5–12 mm wide below the mouth, 8-ribbed, finely pubescent, with some hairs gland-tipped, villous within near base, sepals ovate to lance-ovate, divergent, 1 5–2 5 cm long, 0 7–1 2 cm wide, tips greenish yellow, somewhat pubescent on both surfaces, obtusish, connate about half their length, petals 0, episepalous stamens about three-fourths the sepals, alternate ones slightly shorter, filaments glabrous, anthers yellow, 2 5–4 5 mm long; style pubescent just above the ovary, slender, exserted 5–20 mm beyond the calyx, stigma conicospherical, greenish, 2–4 mm long, scarcely lobed

Type locality, Cundimarca, Peru Material seen, PERU locality not given, *Pavón 1826, as apetala,* Geneva specimen (photo F, POM), Peru, mixed with *apetala, Ruiz and Pavón,* Madrid Herb (F) Húanuco Villcabamba, hacienda on Río Chinchao, 1800 m, *Macbride 4970* (F, GH), Tambo de Vaca, 4000 m, *Macbride 4901* (F, GH, US) Apurimac prov de Abancay, bosques del Ampay, 3200–3500 m, *C Vargas C 1000* (GH) Dept not known Lucumayo Valley, 1800–3600 m, *Cook and Gilbert 1312* (US) *Macbride 4970* and *Vargas 1000* tend to have the hypanthium somewhat fusiform and for a time seemed to me worth recognizing as a separate entity, but the material is insufficient

(83) **Fuchsia cestroides** Schulze-Menz

(Plate 14, fig 74)

Fuchsia cestroides Schulze-Menz, Notizbl Bot Gart, Berlin, 15 317, 1940; Macbride, Field Mus. Nat Hist., Bot 13, part 4, no 1 550, 1941

Erect shrub, 3 m tall, the young twigs densely puberulent to subpilose, 1 5–3 mm thick, somewhat reddish in color, leaves present at anthesis, mostly ternate, not crowded, firm-membranaceous, elliptic-obovate to oblong-ovate, obtuse to acute at base, acuminate to acute at apex, plainly and rather closely serrulate, subglabrous to hispidulous-puberulent above, paler and short-pilose beneath especially on the veins, principal lateral veins 14–16 on each side of midrib, submarginal scarcely developed; leaf-blades 4–8 (10) cm long, 2–3 5 (4) cm wide, petioles 3–6 mm long, pubescent, stipules subulate, often reflexed, about 1 mm long, deciduous, flowers numerous in short lateral racemes or terminal panicles, bracts lanceolate to linear, pilose, 3–15 mm long, pedicels pilose, slender, 3–5 mm. long, ovary fusiform, pilose, 2–4 mm. long; hypanthium dark red, 17–18 mm long, 1–1 5 mm wide at base, then somewhat narrowed until gradually widened to 4 mm at summit, pilose without, glabrous within, sepals lanceolate, 6–7 mm long, 2 5 mm wide, pilose on backs, somewhat divergent, acute, petals 0, stamens 7–8 and 5–6 mm long, exserted, anthers 1 mm long, style glabrous, exceeding sepals by 6–7 mm, stigma narrow, about 1 mm long, berry apparently ellipsoid, at least 6 mm long

Type locality, below Frias, prov Ayabaca, Piura, Peru, at 1100–1200 m, the type collection, *Weberbauer 6423* (F, GH, US) This species is not at all close to the other apetalous ones, and probably should not be placed with them It differs in its many veins, smaller flowers, etc, and suggests in general appearance *F Lehmannii*.

SECTION 6 SCHUFIA (Spach) Munz new section

Schufia, as genus, SPACH, Ann Sci Nat., (2), 4 177, 1835
Schufia, as subsection, ENDLICHER, Gen Pl, 1193, 1840

Flowers erect in a terminal cymose panicle, arranged subtrichotomously Leaves opposite or verticillate Nectary fused with base of hypanthium

One species, *F arborescens* Sims

(84) **Fuchsia aborescens** Sims

Fuchsia arborescens SIMS, Curtis Bot Mag, 53 2620, 1826

Low shrub to small tree up to 8 m tall, sometimes epiphytic, glabrous or nearly so, branchlets, petioles and veins sometimes tinged with red, leaves opposite or ternate, oblong-oblanceolate to oblong-elliptic, acute or acuminate at both ends, paler beneath than above, entire to serrulate, blades 3–20 cm long, 1–7 cm wide, with 9–13 principal lateral veins, flowers numerous, crowded in corymbose panicles 5–25 cm long and equally wide, lower branches of inflorescence with few reduced leaves, upper floriferous ones with much reduced, deciduous, subulate bracts, pedicels reddish, slender, erect, 5–15 (25) mm long, hypanthium tubular to funnelform, rose to magenta, 3–5 mm long, 1–3 mm wide at summit in pressed specimens; sepals reddish to wine-purple, linear to lance-oblong, not apiculate in bud, 3–7 mm. long, 1–2 5 mm wide, spreading-reflexed at anthesis, petals lavender or lilac, lance-ovate, two-thirds as long as sepals, spreading, episepalous stamens exceeding sepals, 4–8 mm long, epipetalous two-thirds as long, filaments pinkish lavender, anthers purplish, 1–1.6 mm long, style just longer than stamens, filiform, glabrous, stigma purplish, conic, about 0.5 mm long, berry purplish, covered with blue bloom, subglobose, 7–10 mm thick.

Key to Forms of *Fuchsia arborescens*

A. Sepals 4.5–7 mm. long; hypanthium 4.5–8 mm. long.
  B. Sepals 1.5–2.5 mm. wide; hypanthium 2–3 mm. wide. 84a. f. *typica.*
  BB. Sepals 1–1.5 mm. wide; hypanthium 1 mm. wide. 84b. f. *tenuis.*
AA. Sepals 3–4.5 mm. long; hypanthium 3–4 mm. long. 84c. f. *parva.*

(84a) **Fuchsia arborescens** Sims forma **typica** new name

(Plate 14, fig. 75)

F. arborescens Sims, Curtis Bot. Mag., 2620, 1826; Lindl., Bot. Reg., 11: 943, 1826.
Schufia arborescens Spach, Ann. Sci. Nat., (2), 4: 177, 1835.
F. hamelioides Moc. and Sessé ex G. Don, Gen. Syst., 2: 677, 1832, in synon. Have seen no material.
F. syringaeflora Carr., Rev. Hortic., 1873: 311, 1873, judging from plate.
F. arborea Sessé and Moc., Pl. N. Hispan., ed. 1, 58, 1887–'90, type seen.
F. arborescens var. (?) *megalantha* Donnell Smith, Bot. Gaz., 18: 2, 1893. Type seen, agrees well in broad sepals, etc., with Sims' plate.
F. Liebmanni Lévl., Bull. Georgr. Bot., 22: 24, 1912. Photograph of type seen.

Hypanthium 4.5–8 mm. long, 2–3 mm. wide at summit; sepals 4.5–7 mm. long, mostly 2–2.5 mm. wide.

Type locality, Mexico. Ranging at altitudes of 1000–2500 m., from Morelos and Guerrero to Panamá; the most common form of the species. In this treatment of *F. arborescens,* forms rather than varieties are being recognized, since there is no geographical correlation and the intergradation is so complete. Representative material of f. *typica* is, MEXICO, without definite locality, *"F. arborea," Sessé, Mociño, Castillo y Maldonado 5216* (F). Morelos, mts. above Cuernavaca, *Pringle 6825* (F, GH, MICH, NY, POM, US). Guerrero, Sierra Madre del Sur, Distrito Mina, 2d ridge west of Petlacala, *Mexia 9052* (GH, NY). Vera Cruz, Xalapa, *Galeotti 3035* (NY). Puebla, St. Vincent, *Nicolas 11* (F, NY); Puebla, *Bro. Arsène in 1909* (US). Oaxaca, Sierra de San Felipe, *Pringle 6242* (F, NY, GH, CAS, POM, US); Barranca de San Luis, *Conzatti 1538* (US). GUATEMALA: Alta Vera Paz, near San José, s.e. of Tactic, *Standley 69660* (F); Tactic, *von Tuerckheim under J. D. Smith 8395* (F, NY, US). Quezaltenango, Volcán de Santa María, *Steyermark 33616* (F); Cumbre de Tuilacán, *Standley 67808* (F); Volcán de Zunil, *Skutch 877* (F). Chimaltenango, Chichavac Tecpán, *Skutch 255* (US); Chichavac, *Skutch 59* (US); Las Calderas, *Standley 60074* (F). Sacatepéquez, Volcán de Agua, *Maxon and Hay 3745* (US), *Standley 65066* (F); Volcán de Acatenango, *J. D. Smith 2469,* type no var. *megalantha* (GH, US). COSTA RICA: Alajuela, Volcán de Poás, *Cufodontis 601* (F). San José, La Hondura, *Standley 36587* (US); between Guayabillos and Cabeza de Vaca, *Dodge and Thomas 4936* (F, MICH, US); La Palma, *Tonduz under J. D. Smith 7410* (F, GH, US). Cartago, Volcán de Turrialba, *Pittier under J. D. Smith 7508* (F, US); Volcán de Irazú, *Oersted,* type *F. Liebmanni* at Copenhagen (photographs F, POM). PANAMA: Chiriquí, el Boquete, *Pittier 2974* (US); Casita Alta, Volcán de Chiriquí, *Woodson, Allen and Seibert 797* (MO, POM).

(84b) Fuchsia arborescens Sims forma tenuis new form

Hypanthium tubular, 5–6 mm long, 1 mm wide; sepals linear, 5–6 mm long, 1–1.5 mm wide

Hypanthium tubulosum, 5–6 mm longum, 1 mm. latum, sepalis linearibus, 5–6 mm longis, 1–1.5 mm latis

Type · **Vara Blanca de Sarapiquí, north slope of Central Cordillera, between Poás** and **Barba Volcanoes, Costa Rica, alt. 1740 m.**, Oct, 1937, *A F Skutch 3357* (US 1643234); isotype (NY) With about some range as f *typica* Representative material, MEXICO: Michoacán and Guerrero, Sierra Madre, *Langlassé 872* (F, GH, US) Orizaba, *Bottera* (F, GH) Chiapas, San Cristóbal, *E W Nelson 3236a* (US); Mt Pasitar, *Matuda 1695* (MICH) GUATEMALA Alta Vera Paz, Cobán, *von Tuerckheim II 713* (F, US) Quezaltenango Fuentes Georginas, w slope Volcán de Zunil, *Standley 67493* (F) Solola, Volcán de Atitlan, *Hatch and Wilson in 1936* (F) Chimaltenango Chichavac, *Skutch 750* (F) PANAMA Chiriquí Casita Alta, Volcán de Chiriquí, *Woodson, Allen and Seibert 911* (MO, POM), El Boquete, *Maxon 5015* (NY, GH, US) COLOMBIA Dept Boyacá Labranzgrande, 1150 m, *B Guevara Amórtegui 389*, in 1932 (F, US) Since this is the only collection I have seen from south of Panamá, I cannot help wonder whether it represents an introduction or not

Intergrades with f *typica* are numerous, among such may be cited, Oaxaca Coyula a Cuyamecalco, *Conzatti 2438* (US), Chiapas, Mt Orlando, *Matuda 0437* (F, MICH, US), Vera Paz in Guatemala Chucaneb, *J D Smith 182* (F, GH, NY, US), Huehuetenango, Yalambofroch, *Seler 2869* (GH, US), San José in Costa Rica Between Aserri and Tarbaca, *Standley 34100* (US)

(84c) Fuchsia arborescens Sims forma parva Munz, new form

F paniculata Lindl., Gard Chron., 1856 801, 1856. Type not seen, but the "much smaller flowers" of the description would probably mean this.

Hypanthium funnelform, 3–4 mm long, 1.5 mm. wide, sepals 3–4 mm long, 1 mm wide

Hypanthium 3–4 mm longum, 1.5 mm latum; sepalis 3–4 mm. longis, 1 mm latis.

Type. **Finca Pireneos, below Santa María de Jesús, Dept. Quezaltenango, Guatemala,** March 11, 1939, *Standley 68287*, Pomona College Herb No 254648, isotype Field Museum 988800 With much the same range as the other forms, for example, MEXICO Oaxaca, Tonaguia, *Galeotti 3035* (US). Vera Cruz, Jalapa, *Walters* (NY), Barranca de Tenampa, Zacuapan, *Purpus 7647* (NY, US) Chiapas, Volcán de Tacaná, *Matuda 2924* (MICH), Cerro del Boquerón, *Purpus 6970* (NY, US). GAUTEMALA Quezaltenango, Fuentes Georginas, Volcán de Zunil, *Standley 67356* (F, POM); Pirenos above San Felipe, *Standley 68287* (F, POM). Quiché, San Miguel Uspantán, *Heyde and Lux* under *J D Smith 3000* (US). Alta Vera Paz · Cobán, *von Tuerckheim in 1908* (NY) Sacatepéquez, Volcán de Agua, *Kellerman in 1905* (US) Zacapa, Sierra de las Minas, *Steyermark 29996* (F). Chiquimula, Montaña Norte to El Jutal, *Steyermark 31042* (F) COSTA RICA Alajuela, La Ventolera, Volcán de Poás, *Standley 34580* (US) PANAMA · Chiriquí, Río Chiriquí Viejo, *Allen 1351* (MO, NY, GH, POM), *White 179* (MO, POM)

Intergrades with f *tenuis* are, MEXICO, Chiapas, Mt Pasitar, *Matuda 1695* (MICH, NY) COSTA RICA · San José, Laguna de la Chonta, *Standley 42260* (US), Cartago, Volcán de Irazú, La Esperanza, *Standley 35374* (US)

SECTION 7 ENCLIANDRA (Zucc) Endlicher

Encliandra (Zucc) ENDLICHER, Gen Pl., 1183, 1840, BENTH and HOOK, Gen. Pl, 1, part 3 · 791, 1862.

As genus, ZUCCARINI, Abh Akad. Muenchen, II · 335, 1837, spelled *Eucliandra*, STEUD, Nom ed, 2, 1 600, 1840.

Brebissonia SPACH, Hist Nat Vég Phan., 4 401, 1835, Ann Sci Nat, (2), 4:175, 1835, as subsect, ENDLICHER, l c

Lyciopsis SPACH, l c, 176, as subsect, ENDLICHER, l c

Myrinia LILJA, Fl sverig Vexter., Suppl 1 25, 1840

Flowers polygamous Petals flat Stamens short, equal, the epipetalous reflexed into the hypanthium Berry few-seeded Slender shrubs with opposite leaves, small solitary axillary flowers

Type species, *Fuchsia Encliandra* Steud

KEY TO SPECIES OF SECTION ENCLIANDRA

A Hypanthium obconic; sepals more than half as long as hypanthium, generally reflexed at anthesis

B Leaf blades mostly less than 2 cm long, rounded to obtuse at base, obtuse to acute at apex, petioles not more than 1 cm long

C Hypanthium 4–6 mm long, sepals 4–5 mm long 85 *F thymifolia*

CC Hypanthium 1–3 mm long; sepals 1 5–3 mm long

D Sepal tips connivent in bud, hypanthium 2–3 mm long

E Petals 2–3 mm long; sepals 2–3 mm. long Hidalgo to Michoacán 86 *F Pringlei.*

EE Petals 1 mm long, sepals 1 5 mm. long Volcán de Colima 87 *F colimae*

DD Sepal tips spreading in bud, hypanthium 1–2 mm long, petals 1–1.5 mm. long Mexico to Chiapas 88 *F minimiflora*

BB Leaf blades mostly 2–5 (7) cm. long, acute at base, subacuminate at apex, petioles 1–3 cm long

C. Hypanthium longer than wide; stamens included, young growth subglabrous to pubescent. 89. *F. tacanensis.*

CC Hypanthium not longer than wide in pressed flowers, stamens evident, young growth fine-strigulose 90. *F. Skutchiana*

AA Hypanthium subcylindric, sepals usually not more than half the hypanthium, ascending to somewhat spreading at anthesis

B Leaves subcoriaceous, frequently conspicuously serrulate.

C. Plant quite glabrous; hypanthium 5–6 mm. long, 1.5–2.5 mm. wide at summit, sepals 3–5 mm long. Guerrero to Chiapas. 91. *F. bacillaris*

CC. Plant puberulent on young twigs, hypanthia, etc.

D Leaf blades 3–8 (10) mm long, hypanthium 3–4 mm. long; sepals 2–2 5 mm. long, petals 1.5–2 mm. long Hidalgo, Vera Cruz, Mexico. 92. *F. minutiflora.*

DD Leaf-blades 7–20 or more mm. long
E Hypanthium 5–9 (11) mm. long, sepals 2.5–5 mm. long
F Hypanthium 7–9 (11) mm long, 2.5–5 (6) mm. wide in the perfect flowers Hidalgo to Guatemala 93 *F. microphylla.*
FF Hypanthium 5–7 (9) mm. long, 1–2 mm. wide. Costa Rica to Panamá 94 *F Hemsleyana.*
EE Hypanthium 3–4 mm long, 1 mm wide, sepals 2 mm long Chiapas. 95 *F striolata.*
BB Leaves membranaceous, often subentire
C Leaf blades mostly less than 3 cm long, usually pilose beneath, sepals 2–3 mm long, petals 0 6–2 mm long Michoacán to Costa Rica 96 *F michoacanensis*
CC Leaf blades not pilose beneath, or if so, larger
D The leaf blades 8–15 (20) mm long, hypanthium of staminate flowers 6–8 mm long, 2–3 mm wide Hidalgo to Oaxaca 97 *F Encliandra*
DD. Leaf blades 20–60 (100) mm. long, hypanthium of staminate flowers mostly 8–10 mm long, 2 5–3 5 mm wide
E Hypanthium of pistillate flowers 1–3 mm wide, petals red, leaves pubescent or pilose beneath
F Petioles 3–10 (12) mm long, branchlets pubescent; leaves subglabrous to strigose above, pilose beneath State of Mexico to Oaxaca 98 *F cylindracea*
FF Petioles 15–30 (40) mm long, branchlets puberulent, leaves pubescent on both surfaces. Oaxaca to Guatemala 99 *F tetradactyla*
EE Hypanthium of pistillate flowers barely 1 mm wide, petals apparently white, leaves subglabrous to minutely puberulent on both surfaces Jalisco to Morelos . 100 *F Mexiae*

(85) **Fuchsia thymifolia** H B.K

(Plate 15, fig. 76)

Fuchsia thymifolia H B K , Nov Gen et Sp , 6.104, pl. 535, 1823 *F. thymifolia* DC , Prodr , 3 37, 1828, Lindl , Bot Reg , 15 1284, 1829, Sweet, Brit Fl. Gard , 4 25, 1829, Hemsley, Bot Biol. Centr Amer , 1 460, 1880, Standley, Contr U S Nat Herb , 23 1079, 1924

Lopezia thymifolia Willd., herb Link, Jahrb , I 3 25, ex Link in Schult , Mant , 1 50, according to H.B K , l.c ,

Lyciopsis thymifolia Spach, Ann Sci Nat , (2) 4 176, 1835

Encliandra thymifolia Lilja, Linnaea, 15 262, 1841.

Fuchsia alternans Moc and Sessé, Fl Mex Icon ined , ex DC , Prodr., 3:37, 1828, in synon

F parviflora Lindl., Bot Reg , 13 1048, 1827 Type not seen, but the figure given is good

F ovata Sessé and Mociño ex DC , Prodr , 3·37, 1828, in synon Not seen

Shrub about 1 m tall, openly branched, with slender puberulent somewhat reddish twigs, the ultimate ones scarcely 1 mm thick, leaves opposite to alternate, not crowded, elliptic-ovate to round-ovate, subentire, rounded to obtuse at base, obtuse to acute at apex, membranaceous, paler beneath than above, minutely pubescent to subglabrous above, minutely pubescent beneath, somewhat ciliate, the blades 0 7–2 (3) cm long, 0 5–1 6 cm wide, with 3–5 pairs lateral veins, petioles very slender, puberulent, 3–10 mm. long, often reddish, stipules subulate, somewhat glandular, scarcely 1 mm long, flowers solitary, axillary, white to pink, darker in age, pedicels puberulent, filiform, 5–10 (12) mm. long; hypanthium puberulent without and within, obconic, 4–6 mm. long, 2–3 mm wide at summit in pressed specimens, whitish to reddish (especially in age), sepals ovate, puberulent, about 4 mm long, white and spreading-reflexed at anthesis, later red, the subulate tips connivent in bud, 1 mm. long, petals ovate-oblong, spreading, 4 mm long, white becoming purplish red, obtuse, often undulate, stamens subsessile, the episepalous ones exserted from hypanthium, 1.5 mm long, the epipetalous included, 1 mm long, style white, glabrous, exserted, 6–9 mm long from base of hypanthium, stigma greenish, the lobes erect or spreading, barely 0.5 mm long, berry globose, glabrate to puberulent, 4–6 mm long

Type locality, Pátzcuaro, Michoacán, Mexico Ranging through several states of south central Mexico, representative material, without locality, fragment *Bonpland 4106* (F), ex horto bot petropolitano, seeds from Mexico, in 1828 (NY), *Coulter 176* (NY) Hidalgo, Sierra de Pachuca, *Rose and Painter 8023* (US), *6737* (GH, NY, US), *Pringle 9472* (G, US in part), *9794* (F, GH, MICH, NY, US), *Rose, Painter and Rose 8859* (GH, NY, US), El Chico, *Lyonnet 534* (US) Michoacán, Quinceo near Morelia, *Arsène 3228* (GH, US), Cerro Azul, *Arsène 2453* (US) Mexico, Salazar, *Rose and Painter 7035* (US), Federal District, Cerro Xitle, *Russell and Souviron 175* (US), Eslava, *Rusby 342* (NY, US), Pedregal, *Pringle 7206* (GH, US), Contreras Canyon, *Munz 15001* (POM) Vera Cruz, Pedregal Naolingo, *Purpus 296* (US) Sinaloa, El Carrizo, *Ortega 6009* (US)

(86) **Fuchsia Pringlei** Robinson and Seaton

(Plate 15, fig 77)

Fuchsia Pringlei Robins and Seat, Proc. Amer Acad, 28 106, 1893, Standley, Contr U S Nat Herb, 23 1079, 1924

Habit and pubescence of *F thymifolia,* but leaves closer together, blades mostly less than 1 cm long, 0.3–0.7 (1) cm wide, petioles 2–5 (7) mm long, hypanthium 2–3 mm long, sepals 2–3 mm long, petals 2–3 mm long, style 4–5 mm long

Type locality, Pátzcuaro, Michoacán In the original description were cited Mts near Pátzcuaro, *Pringle 5063,* barranca near Guadalajara, *Pringle 5002,* and Mts near Pátzcuaro, *Pringle 4140.* Since the first two cited were in fruit and only the last had flowers, it should be taken as the type number. Fruiting specimens alone can be distinguished from *F thymifolia* only with difficulty The species ranges with *F thymifolia* Specimens seen, MEXICO "*Fuchsia microphylla* N. ic" *Sessé, Mociño, Castillo, y Maldonado 5210* (F), Salto de Agua, *Purpus 1780* (POM, US) Hidalgo, Pachuca, *Rose and Hough 4452* (GH, US) Mexico, Comunidad, Temascaltepec, *Hinton 1814* (GH, US), Popocatepetl, *Purpus 3059* (NY, US), Ixtaccihuatl, *Purpus 370* (US); Cima, *Rose and Painter 7189* (GH, US), Federal district, Sierra de Ajusco, *Pringle 6412* (CAS in part, F in part, MO, NY, US in part), *11988* (F, GH, MICH, US). Vera Cruz, Acultzinco, *Matuda 1097* (F, MICH, NY); Maltarata, *Matuda 1218* (F, MICH) Morelos, Serrania de Ajusco, *Pringle 7570* (POM); Tres Marías, *Orcutt 3754* (F, US) Michoacán, Morelia, Cerro Azul, *Arsène in 1909* (F, GH); Pátzcuaro, *Pringle 4140*, type no. (F, GH, CAS, NY, US), Tarascon, *Pringle 13463* (US). Tepic, between Santa Gertrudis and Santa Teresa, *Rose 2117* (US) Jalisco, west of Bolaños, *Rose 2964* (US), not typical, flowers white

(87) **Fuchsia minimiflora** Hemsley

(Plate 15, fig. 79)

Fuchsia minimiflora Hemsl., Bot. Biol Centr Amer, 1·458, 1880; 5:pl 28, fig 1, 1880, Standley, Contr U. S Nat Herb, 23 1079, 1924.

Shrub 1–4 m tall, loosely branched with long very slender reddish crisp-puberulent twigs, leaves oposite or alternate, ovate to elliptic-ovate, acute at apex, rounded to obtuse at base, subentire to serrulate, paler beneath, subglabrous to minutely crisp-puberulent, the blades mostly 1–2 cm. long, 0 5–1 2 cm wide, petioles very slender, puberulent, 2–5 mm long, flowers solitary, axillary; pedicels filiform, puberulent, 4–12 mm. long; hypanthium obconic, 1–2 mm long, whitish to reddish, puberulent without; sepals lanceolate, reflexed-spreading, whitish to reddish, 1 5–2 5 mm long, the tips apiculate, spreading in bud, petals oblong-elliptic, white to red, less than 1 5 mm long, stmens subsessile, less than 1 mm long; style glabrous, 2–3 mm long, stigma 4-lobed, the lobes spreading, 0 5–1 mm long; berry subglobose, glabrate to puberulent, 4–5 mm thick

Type locality, Chiapas, Mexico A species of south-central Mexico, known from but few collections, of which I have seen MEXICO, state not known to me, Salto de Agua, *Purpus 1780* in part (F) Mexico, Cima, *Rose and Painter 7189* (US), Federal District, Sierra de Ajusco, *Rose and Hay 5521* (US, *Pringle 6412* in part(F, GH, MO, US), District of Temascaltepec, *Hinton 1351* (F, NY) Puebla, Boca del Monte, *Purpus 5828* (F, GH, NY, US) Chiapas, without definite locality, *Linden 680*, type coll, photo of Geneva specimen (F)

(88) **Fuchsia colimae** Munz, new species

(Plate 15, fig. 78)

Habit and puberulence of *F minimiflora;* leaves orbicular-ovate, the blades 5–12 mm long, 4–11 mm wide, obscurely serrulate, obtuse to rounded at both ends, petioles 3–5 mm long; hypanthium whitish-green, 2–2 5 mm long, sepals white, reflexed-spreading, 1 5 mm long, the tips not free in the bud, petals white, elliptic-oblong, 1 mm long, stigma-lobes spreading

Habitus et puberulencia Fuchsiae minimiflorae, foliis orbiculare-ovatis, laminis 5–12 mm longis, 4–11 mm latis, obscure serrulatis, obtusis vel rotundatis in extremis utrisque, petiolis 3–5 mm longis, hypanthio albido, 2–2 5 mm. longo, sepalis albidis, reflexo-expansis, 1 5 mm longis, petalis albis, elliptico-oblongis, 1 mm. longis, lobis stigmatis expansis.

Type. from Volcano of Colima, Jalisco, Mexico, July 13, 1892, *M E Jones*

294, Pomona College Herbarium 83711; isotypes United States National Herbarium 237441 and at New York Botanical Garden. This species is near *F. minimiflora*, but the sepals are shorter than the hypanthium, the tips are not free in the bud, and the leaves are more rounded.

(89) **Fuchsia tacanensis** Lundell

(Plate 15, fig 80)

Fuchsia tacanensis LUNDELL, Contr Univ Mich. Herb, 4:20, 1940.

Shrub up to 4 m high, open-branched, the ultimate branchlets slender, greenish, subglabrous to pubescent, leaves opposite, the blades membranaceous, rhombic-ovate, abruptly cuneate at base, acuminate at apex, rather evenly and coarsely sinuate-serrulate, paler beneath than above, somewhat strigose above, subglabrous to pilose beneath, 2 5–5 (7) cm long, 1 2–3 5 (4 2) cm wide, with 7–9 pairs of lateral veins, petioles slender, subglabrous to pubescent, 1–2 cm. long, pedicels filiform, glabrous to pubescent, mostly 1–2 cm long, flowers perfect or imperfect, hypanthium obconic, 3–5 5 mm long, 2–3 5 mm wide at summit, glabrous to puberulent, greenish to reddish, sepals reflexed-spreading at anthesis, lanceolate, acuminate, usually somewhat pubescent, whitish or greenish, usually shorter than hypanthium, 2 5–6 mm long, apiculate, the tips 1–2 mm long, connivent in bud; petals oblong-ovate, white to pink, red in age, 2–3 5 mm long, more or less emarginate, stamens included, anthers about 1 mm long, style in perfect flowers 4–7 mm long, stigma 4-lobed, scarcely 1 mm long, fruit subglobose, black, 4–5 mm thick

Type locality, Volcán de Tacaná, Chiapas, Mexico; the species is known from the following collections, all from MEXICO without locality, *Schiede* (US), Morelos, barranca above Cuernavaca, *Pringle 6380* (F, GH, CAS, MICH, NY, US), Chiapas, Volcán de Tacaná, *Matuda 2399* (MICH, type), Mt Pasitar, *Matuda 1686* (MO, NY, MICH, US) *F tacanensis* is variable in flower-size, pubescence, length of hypanthium, etc, but is distinguished by the large thin toothed leaves, wide hypanthium, long sepal-tips, light-colored flowers, sepals shorter than hypanthium *Pringle 6380* has staminate more crowded flowers, pedicels less than 1 cm long.

(90) **Fuchsia Skutchiana** Munz, new species

(Plate 15, fig 81)

Much like *F. tacanensis* in habit, foliage, etc, but finely strigulose on young branchlets, hypanthia, sepals, leaves more finely strigose, petioles 2–3 cm long; pedicels 1.5–3 cm. long, strigulose, hypanthium not longer than wide in pressed specimens, 2–3 mm long, slightly wider; sepals at least as long as hypanthium, reflexed, 2 5–4 mm long, white to pink, aging red, the tips 1–1.5 mm. long, petals about as long as sepals, white to pink, aging red, emarginate; stamens not included, about 1 mm long, anthers 0.5 mm long, style 4–5 mm long, fruit black, 4–5 mm thick.

Habitus et folia *Fuchsiae tacanensis*, ramulis, hypanthiis sepalisque strigulosis, foliis strigulosis, petiolis 2–3 cm longis, pedicellis 1 5–3 cm longis, strigulosis, hypanthio 2–3 mm longo, latiore, sepalis hypanthio aequalibus, reflexis, 2 5–4 mm longis, albis vel carneis, in aetate roseis, cum apicibus 1–1 5 mm longis, petalis sepalis aequalibus, emarginatis, albis vel carneis, in aetate roseis, staminibus non inclusis, 1 mm longis, antheris 0.5 mm longis, stylo 4–5 mm longo, bacca nigra, 4–5 mm diametro

Type from near **Quezaltenango, Quezaltenango, Guatemala,** at **2500 m.,** July 24, 1934, *A F Skutch 812* (NY), isotype (F) Other material from same place and on same date, *Skutch 813* (F), Chiapas, Mexico, *Ghiesbreght 730,* in 1864–'70 (F, GH, MO)

(91) **Fuchsia bacillaris** Lindley

(Plate 15, fig 82)

Fuchsia bacillaris LINDL, Bot Reg, 18 1480, 1832, *F bacillaris* in Curtis, Bot Mag, 76 4506, 1850, HEMSLEY, Biol Centr Amer, Bot, 1 456, 1880, STANDLEY, Contr U S Nat Herb, 23 1079, 1924.

Shrub 1–2 m tall, practically glabrous throughout, openly and finely branched, leaves opposite, subcoriaceous, sinuate-denticulate, paler beneath than above, lance-ovate to elliptic-ovate, more or less cuneate at base, acute to obtuse at apex, sometimes with line of minute hairs on upper surface of midrib, blades 1–3 (4 5) cm long, 0 5–1 2 (1 5) cm wide, petioles 3–6 mm long, sometimes with lines of puberulence, flowers solitary, axillary, apparently perfect or pistillate, pedicels glabrous, filiform, 5–15 mm long, hypanthium subcylindric, glabrous, red, 5–6 mm long, 1 5–2 5 mm wide at summit, sepals spreading-reflexed at anthesis, rose, glabrous, lanceolate, 3–5 mm long, apiculate, the tips connivent in the bud; petals rose, round-obovate, retuse, 2 5–5 mm long, stamens included, the anthers 1–1 5 mm long, style 8–13 mm long, stigma reddish, the 4 lobes tending to spread, fruit spherical, 4–5 mm thick

Type locality, Mexico, seeds sent by J S Mill, Esq This species is an uncertain entity, the exact location of its origin being unknown It has always been keyed out as being glabrous The plate by Lindley shows it as having relatively large flowers and is pretty well matched by *Purpus 6708* Material seen, MEXICO "seed from Mexico, 1829," Ex horto bot Petropolitano (NY), matching the Lindley plate and description and is likely authentic material Guerrero Mts near Chilpancingo, *E W Nelson 2258* (US), with leaves rather small, Sierra Madre, near Chilpancingo, *Nelson 2232* (US), crest of Sierra Madre, *Langlassé 890* (F, GH, US) Chiapas Cerro del Boquerón, *Purpus 6708* (F, GH, NY, US) GUATEMALA Huehuetenango, Sierra Cuchumatanes, *Skutch 1247* (F), twigs slightly pubescent

(92) **Fuchsia minutiflora** Hemsley

Fuchsia minutiflora HEMSL, Diag Pl Nov, 1 15, 1878, Bot Biol Centr Amer, 1 458, 1880, 5 pl 28, 1880, STANDLEY, Contr U S. Nat. Herb, 23 1079, 1924.

Shrub 1–2 m tall, with very slender rather numerous branches, the ultimate ones scarcely 1 mm thick and covered with a loose brownish puberulence, the hairs more or less spreading, often with incurved tips, leaves mostly opposite, numerous, mostly longer than the internodes, the blades thickish, lance-ovate to -elliptic, conspicuously serrulate with 4–5 teeth on each edge, glabrous, somewhat paler beneath, 3–8 (10) mm long, 2–5 (7) mm wide, obtuse to acute at both ends, petioles 1–2 (4) mm long, flowers solitary, axillary; pedicels filiform, sparsely puberulent, 2–8 mm long, hypanthium tubular-funnelform, 3–4 mm long, 1 5 mm thick at base, gradually ampliate, subglabrous to puberulent, apparently reddish, sepals lanceolate, acuminate, apiculate, somewhat spreading in anthesis, 2–2 5 mm long, the tips connivent in the bud, petals oblong, obtuse, entire, 1 5–2 mm long, apparently white, stamens very small, almost included, style glabrous, scarcely as long as petals, stigma deeply 4-lobed, berry sub-globose, subglabrous, 3–4 5 mm thick

KEY TO VARIETIES OF *Fuchsia minutiflora*

A Hypanthium and sepals white, hypanthium pubescent 92a var *hidalgensis*
AA Hypanthium red, subglabrous 92b var *typica*

(92a) **Fuchsia minutiflora** Hemsley, var **hidalgensis** Munz, new variety

(Plate 15, fig 83)

Hypanthium pubescente, album, sepalis albis

Type from **Trinidad, Hidalgo, Mexico, at 1850 m**, April 30, 1904 *Pringle 8808*, Pomona College Herbarium 59867, isotypes (F, GH, CAS, MICH, NY, US), the label on the Michigan specimen reads "Honey Station, Puebla" Material seen, Trinidad, *Pringle 8807* (F, GH, CAS, NY, US), Zacualtipán, *Seler 150* (GH, US)

(92b) **Fuchsia minutiflora** Hemsley, var **typica** Munz, new name

Fuchsia minutiflora HEMSL, Diag Pl Nov, 1 15, 1878

Hypanthium red, subglabrous

Type locality, "in monte Orizaba, alt 5000 ped," based on Linden 631 Material seen, MEXICO without locality, *Mueller 1339* (NY), garden of Mrs Nuttall, Mexico City, *Safford 1511* (US), Vera Cruz, Chinantla, *Liebmann 3231* (US), Prov Jalapa, com Schlechtendal in 1840, coll *Schiede 525* (GH, NY), Aseradero de Santa Cruz, *Mueller 1550* (NY), Orizaba, *Mueller 1702* (GH, NY), *640* (NY), Maltrata, *Matuda 1358* (MICH, NY) Mexico, Ixtaccihuatl, *Purpus 160* (POM)

(93) **Fuchsia microphylla** H B K

Fuchsia microphylla H B K, Nov Gen et Sp, 6 103, pl 584, 1823

Subshrub or shrub, 3–20 dm tall, rather densely branched, the ultimate branchlets slender, barely 1 mm thick, with a dense subappressed puberulence, leaves crowded, opposite, subcoriaceous, lance-oblong, to elliptic-obovate, usually sharply serrulate, sometimes subentire, deep green above, paler beneath, acute to obtuse at both ends, subglabrous except sometimes for line of puberulence along upper surface of midrib, the blades 5–20 (25) mm long, 3–8 (10) mm wide, petioles glabrous to puberulent, 2–8 (15) mm. long; flowers solitary, axillary, perfect or pistillate; pedicels appressed-puberulent, 3–6 (10) mm long; hypanthium deep red, subcylindric, constricted above the ovary, then usually 7–9 (11) mm long, 2 5–5 (6) mm wide in pressed specimens, sometimes shorter and narrower in pistillate flowers, glabrous to minutely strigose, sepals deep red, mostly 4, sometimes 3, lanceolate to ovate, 2 5–5 (7) mm long, acuminate, usually apiculate, the tips up to 1 mm long and connivent in the bud, glabrous to strigulose, petals rose, broadly elliptic to almost round, usually toothed, 3–5 (7) mm long, stamens nearly or quite included, anthers 1 5–2 mm. long, sometimes lacking; style 8–15 (20) mm long, stigma reddish, deeply 4-lobed; fruit subglobose, glabrous to strigulose, purple-black when ripe, up to 8 mm thick

Characterized by its coriaceous glabrous usually serrulate and smallish crowded leaves and rather large flowers, but variable, flowers small if pistillate only

Key to Varieties of *Fuchsia microphylla*

A Ovary and hypanthium glabrous. . 93a var *typica*
AA Ovary and lower part of hypanthium minutely strigulose 93b var *aprica*

(93a) **Fuchsia microphylla** H B K var **typica** Munz, new name

(Plate 15, fig 84)

F microphylla H B K, Nov Gen. et Sp., 6 103, pl 534, 1823, Lindl, Bot Reg, 15 1269, 1829, Sweet, Brit Fl Gard, ser 2, pl 16, 1829?, Hemsley, Bot Biol. Centr Amer, 1 458, 1880 in part, Standley, Contr U S Nat Herb, 23 1079, 1924 in part

Brebissonia microphylla Spach, Ann Sci. Nat, ser II, 4 175, 1835

Myrinia microphylla Lilja, Fl Sverig Suppl., 1 25, 1840

F gracilis Sessé and Mociño ex DC., Prodr., 3 37, 1828 in synon

F mixta Hemsley, Diag Pl. Nov, 1·14, 1878; Biol Centr. Amer Bot., 1·459, 1880, 5 pl 28, fig 2, 1880 Based on Galeotti 3025 from Orizaba, which I have not seen, but which is in the range of the typical form if referred to *F. microphylla* I agree with Standl, l.c, that such must be the case

Ovary and hypanthium glabrous

Type locality, Volcán de Jorullo, which I believe is in Michoacán, Mexico Ranging from Hidalgo to states of Mexico, Michoacán and Jalisco Material seen, MEXICO without definite locality, *Sessé, Mociño, Castillo y Maldonado 5197* (F); Lithrum vulnerarium, N, *Sessé et al 1842* (F); ex horto bot. Petropolitano, introd 1828 from Mex. (NY) Hidalgo, El Chico, *Lyonnet 2204* (US); between Real del Monte and Chico, *Hartweg 285* (NY); Lagunas Zempoala, *Lyonnet 2510* (US) Vera Cruz, Pico de Orizaba, Vacqueria de Jacal, *Liebmann 3230* (US, GH). Federal District, El Desierto, Convieto, *Russell and Souviron 133* (CAS, US); La Cima, *Barnes and Land 395* (F), San Nicolás, Valle de Mexico, *Bourgeau 974* (GH, US), Pass near Desierto de los Leones, *Munz 15062* (POM) intergrading toward *aprica;* Contreras, *Lyonnet 1637* (US). Mexico, Salazar, *Pringle 13462* (US), *Rose and Painter 7036* (US), Montes de Gavia, *Asplund 356* (NY); Nevada de Toluca, *Rose* *and Painter 7935* (NY, US), Sierra de las Cruces, *Pringle 4314* (F, GH, MICH, NY, US), Ixtaccihuatl, *Purpus 1779* (F, GH, NY, POM, US), Méson Viejo, Temascaltepec, *Hinton 1902* (US), San Rafael, *Lyonnet and Elcoro 1923* (US) Morelos, Popocatepetl, *Purpus 3060* (F, NY, GH, US), *Rose and Hay 6256* (US) Michoacán, Mt Patamban, *Nelson 6566* (NY, US), "in monte ignivomo Jorullo, alt 550 hex," *Humboldt et al,* type coll. (scrap at F). Jalisco, volcano of Colima, *Jones 225* (POM, US)

(93b) **Fuchsia microphylla** H B K var **aprica** (Lundell), new comb

F aprica LUNDELL, Contr. Univ Mich Herb, 4.18–19, 1940

Ovary and lower part of hypanthium minutely appressed-puberulent

Type locality, Volcán de Tacaná, Chiapas, Mexico Ranging from Oaxaca and Chiapas to Guatemala. Representative material seen, MEXICO, Puebla, Tezuitlan, *Orcutt 4001* (F, MO, US) Oaxaca, Yavezca, *Galeotti 3039* (US), Cerro de los Frailes, between Teotitlán del Camino and Huantla de Jiménez, *Schultes and Reko 370* (F, GH) Chiapas, San Cristóbal, *Goldman 985* (US), Mt Tacaná, *Matuda 2378,* type coll *aprica* (MICH, NY) GUATEMALA Alta Vera Paz, Mts east of Tactic, *Standley 71428* (F) Huehuetenango, San Juan Ixcoy, *Skutch 1069* (F) Quiché, San Miguel Uspantán, *Heyde and Lux under J. D Smith 2999B* (NY, US), Nebaj, *Skutch 1711* (F) pistillate San Marcos, Volcán de Tajumulco, *Schmidt 1934* (F), Volcán de Tacaná, *Steyermark 36159* (F) Quezaltenango, Volcán de Santa María, *Steyermark 34187* (F) Chimaltenango, Volcán de Acatenango, *Standley 61954* (F), Volcán de Agua, *Johnston 896* (F) Guatemala, between San Martin and Todos Santos, *Nelson 3627,* pistillate (F, US) Sacatepéquez, Antigua, *Kellerman 6535* (F), Volcán de Agua, *Kellerman 7577* (NY)

This pubescent plant intergrades freely with *F michoacanensis* which has thinner more membranaceous leaves with coarser longer hairs on their lower surface, for example GUATEMALA Quezaltenango, *Hartweg 527* (NY), Sacatepéquez, Volcán de Agua, *Shannon 3655* (US), Alta Vera Paz, Cobán, *von Tuerckheim II 1295* (F, MICH, NY), Mts east of Tactic, *Standley 71357* (F) Oaxaca, Cerro de la Virgen, *Conzatti 4352* (US) In these and many others, one gets varying combinations of thick leaves and pilosity

(94) **Fuchsia Hemsleyana** Woodson and Seibert

(Plate 15, fig 85)

Fuchsia Hemsleyana WOODSON and SEIBERT, Ann Mo. Bot Gard, 24 194, 1937
F. pulchella WOODSON and SEIBERT, l.c, 195–196. Based on *Seibert 188,* which I have seen

Shrub 1–3 m tall, rather openly branched, the ultimate branchlets slender, ca 1 mm thick, minutely pubescent, sometimes strigulose; leaves mostly opposite, rather crowded, subcoriaceous, rhomboid-elliptic to -obovate, cuneate at base, acute to obtusish at apex, serrulate to sinuate-dentate, paler beneath than above, subglabrous except on upper surface of midrib and along margin, the blades 7–15 (25) mm. long, 4–8 (12) mm wide, petioles sparsely puberulent, 3–8 (12) mm long, flowers solitary, axillary, perfect or pistillate; pedicels filiform, more or less puberulent, 4–6 (8) mm long, hypanthium rose, tubular, constricted above ovary, then 5–7 (9) mm long, 1–2 mm wide at summit, glabrous to puberulent, sepals deltoid-lanceolate, rose, spreading-reflexed at anthesis, 3 5–4 mm long, apiculate, the tips connivent in the bud, petals rose or with purplish tinge, oblong-obovate, 2 5–4 mm long, undulate and rounded at apex, stamens usually included, anthers 1–1 2 mm long; style 8–10 mm long, stigma deeply 4-lobed, exserted, 1 mm long, ovary subglabrous to strigulose, fruit subglobose, black-purple, 4–5 mm thick

Type locality, Río Chiriquí Viejo, near Monte Lirio, Chiriquí, Panamá Found in the mountain of Costa Rica and Panamá Representative material may be cited, COSTA RICA Vara Blanca de Sarapiquí, *Skutch 3225* (NY) Alajuela, Volcán de Poás, *Standley 34629* (US), *34620* (US), *Allen 600* (F) Cartago, Cerros de Irazú, *Pittier 13048* (US), Volcán de Turrialba, *Standley 34949* (US) San José, La Guaba, *Valerio 1526* (F), Laguna de la Chonta, *Standley 42275*, strigulose (F, US), Cerro de Piedra Blanca, above Escasú, *Standley 32598* (US), *Solis 154* (F) strigulose, Finca La Cima above Los Lotes, *Standley 42758* (US), Cerro de Las Vueltas, *Standley and Valerio 43523* (F, US), *43499* (US), Laguna de la Escuadra, n e of El Copey, *Standley 42078* (F, US), *42057* (US), between Guayabillos and Cabeza de Vaca, *Dodge and Thomas 4940* (F) PANAMA Chiriquí, upper Río Chiriquí Viejo, *Seibert 162*, type no *Hemsleyana* (MO, NY), near Monte Lirio, *Seibert 182*, type *pulchella* (MO), Río Chiriquí Viejo valley, *White 2* (GH, POM), trail Paso Ancho to Monte Lirio, *Allen 1497* (MO, NY, POM), Volcán de Chiriquí, *Terry 1331* (F, MO), *Davidson 876* (F, MO), Casita Alta, *Woodson, Allen and Seibert 873* (MO, POM), Bajo Chorro, Boquete District, *Davidson 319* (F, MO), Cuesta de Cerro Quemado, *Pittier 3114* (US, GH)

This species is near *F. microphylla* in its coriaceous, smallish, usually toothed leaves, but has smaller flowers and a more southern range It often is much like *F michoacanensis*, but the leaves are thicker, smaller, not pilose, however, it intergrades with it (see under *michoacanensis*) Plants that I refer to *Hemsleyana* have largely been determined as *F parviflora* (*F Encliandra* of this paper), but that species belongs in the thinner or membranaceous-leaved group

(95) **Fuchsia striolata** Lundell

(Plate 15, fig 86)

Fuchsia striolata Lundell, Contr Univ Mich Herb, 4 20, 1940

Shrub, openly branched, more or less scandent, the ultimate branchlets somewhat strigulose; leaves opposite, subcoriaceous, ovate to lance-ovate, the blades 1 5–9 0 cm long, 1–5 cm wide, cuneate at base, acuminate to acutish at apex, minutely strigulose above, subglabrous and paler beneath, subentire to remotely denticulate in upper half, ciliolate, with 6–7 pairs of lateral veins; petioles strigulose, 1–2 5 cm long, flowers solitary, red, pedicels strigulose, 6–12 mm. long; hypanthium tubular, strigulose, 3–4 mm. long, barely 1 mm. wide; sepals red, deltoid, ca 2 mm. long, apiculate; petals red, 1 mm. long, rounded; anthers included, 0 6 mm long, style 4–5 mm long, stigma exserted, 4-lobed, less than 1 mm. long; fruit subglobose, ca 7 mm. thick, strigulose

Type locality, Volcán de Tacaná, Chiapas, Mexico, the type number being *Matuda 2765* (F, MICH, NY) entirely without flowers, although the sheet at New York has one young bud On the whole, though, *Matuda 2765* seems to match *Matuda 4004*, from Mt. Ovando, Chiapas (MICH, NY) which does have flowers From GUATEMALA · San Marcos, Volcán Tacaná, Quebrada Canjulá, between Sibinal and Canjulá, *Steyermark 3608.* (F) also without flowers, seems to be this species It is characterized by the large thickish leaves which are quite glabrous beneath and with short pedicels and small flowers A collection from Jalisco, San Sebastian, Cañon El Ranchito, *Mexia 1465* (F, MICH, NY, US) has certain characters of *F striolata* (leaf-shape, size, pubescence; pedicel-length, flower-size, shape, color; fruit-size), but the leaves are very much thinner than in the Chiapas specimens

(96) **Fuchsia michoacanensis** Sessé and Mociño

(Plate 15, fig. 87)

Fuchsia michoacanensis SESSÉ and MOCIÑO, Pl N Hispan, ed 1, 57, 1887–90

Fuchsia biflora SESSÉ and MOCIÑO, Fl. Mex, ed 2, 93, 1894 given as same as *F michoacanensis* Based on specimen no 5209, which I have seen

F chiapensis T. S. BRANDG, Univ. Calif Pub Bot., 6.59, 1914, STANDLEY, Contr. U. S Nat Herb 23:1079, 1924. Based on *Purpus 6707*, which I have seen

F heterotricha LUNDELL, Contr Mich. Herb, 4:19, 1940 Based on *Matuda 2457*, which I have seen It may have somewhat finer pubescence than usual

Shrub 1–3 m tall, with slender branches, the ultimate ones about 1 mm thick, adpressed-puberulent to densely spreading-pubescent or pilose, usually with both kinds of hairs at least on the petioles and veins of lower leaf-surfaces, leaves opposite, the blades orbicular-ovate or elliptic-ovate, membranaceous, subentire, to denticulate, bicolored, rounded to cuneate at base, rounded to acute at apex, subglabrous to puberulent or sparingly strigose above, sparsely to densely pilose beneath, 7–25 (40) mm. long, 5–20 (25) mm wide; petioles 3–25 mm long, usually pilose and strigulose, flowers axillary, perfect or pistillate, pedicels pilose to puberulent, filiform, 5–15 (25) mm long; hypanthium red, cylindrical in pistillate flowers to tubular-funnelform in perfect ones, often more or less pilose, pubescent, 4–6 (10) mm. long, 1–3 mm. wide at apex in pressed specimens, constricted below the rounded base, sepals red, usually pilose, sometimes only puberulent, more or less spreading, deltoid, acuminate, 2–3 mm long, the apiculate tips connivent in bud, petals coral red, round-ovate to -elliptic, erect, 0 6–2 mm long; stamens subsessile, almost or quite included; style 6–8 (12) mm long, the stigma somewhat exserted, deeply 4-lobed, more or less red, berry subglobose, black-purple, 4–7 mm. thick

Type locality, not given, probably southern Mexico. Ranging from southern Mexico to Costa Rica Representative material, MEXICO without definite locality, "*Fuchsia biflora* N t 2. f 159," *Sessé, Mociño, Castillo and Maldonado 5209* (fragment at F) Mexico, district of Temascaltepec, Pantoja, *Hinton 2846* (NY) Michoacán, Tarascón, *Pringle 11989* (F, GH, US) Chiapas, Cerro del Boquerón, *Purpus 6707*, type no *chiapensis* (F, GH, NY, US), *7168* (F, NY, US), Volcán de Tacaná, *Matuda 2457*, type *heterotricha* (MICH) Jalisco, Real Alto, trail to El Tajo de Santiago, *Mexia 1744* (F, CAS, MICH, NY, US) Morelos, El Parque, *Rose and Rose 11118* (NY, US) very smooth GUATEMALA San Marcos, Quebrada Conjulá, Volcán Tacaná, *Steyermark 36047* (F), Río Vega, Volcán Tacaná, *Steyermark 36233* (F), El Boquerón, *Standley 66305* (F, POM) Quiché, so of Chichicastenango, *Standley 62408* (F) Chimaltenango, Chichivac, *Skutch 43* (US), *710* (F); Cerro de Tecpám, *Standley 58716* (F) Guatemala, Finca La Aurora, *Aguilar 80* (F), Volcán de Pacaya, above Las Calderas, *Standley 58400* (F, POM) Quezaltenango, Volcán Santa María, *Steyermark 33915* (F), above Santa María de Jesús, *Standley 67264* (F), *67188* (F), Volcán Zunil, *Steyermark 34929* (F) Jalapa, Volcán Jumay, *Steyermark 32353* (F) Amatitlán, between San Vicente Pacaya and El Cedro, *Tonduz 428* (US) Sacatepéquez, Volcán de Fuego, *J D Smith 1460* (GH, US), Volcán de Agua, so of Santa María de Jesús, *Standley 59494* (F, POM), Finca Carmona, s e of Antigua, *Standley 63805* (F, POM) Sacapa, Sierra de las Minas, *Steyermark 29741* (F) EL SALVADOR San Vicente, Volcán de San Vicente, *Standley 21549* (NY, GH, US) COSTA RICA San José, Las Nubes, *Standley 38705* (US)

Material which I refer to this species has largely passed as *F minutiflora* which is a smaller-leaved and smaller-flowered plant of more northern range *F michoacanensis* intergrades freely with *F microphylla* var *aprica* especially in Guatemala, where much of the material is intermediate In Costa Rica, it intergrades likewise with *F Hemsleyana*, but in general, *F michoacanensis* has thin leaves while the other two have more coriaceous ones Examples of intergradation with *microphylla* are, Chiapas, *Ghiesbraght 697* (F), Barranca Eminencia, San Marcos, Guatemala, *Standley 68586* (F), Cerro Quemado, Quezaltenango, *Kellerman 5939* (US), San Juan de Dios, Sonsonate, El Salvador, *Pittier 1995* (US), Volcán de San Salvador, *Standley 22810* (NY, GH, US) In these there is a tendency toward the pubescence of *michoacanensis* and toward the small thickish leaves of *microphylla* With the pubescence of *F michoacanensis*, but the leaf-thickness of *F Hemsleyana* may be cited, COSTA RICA Cartago, *Torres Rojas 48* (US), Volcán de Turrialba, *Pittier 13191* (GH, NY, US), Irazú, *Kuntze 2343* (NY).

(97) **Fuchsia Encliandra** Steudel

(Plate 15, fig 88)

Fuchsia Encliandra STEUD, Nomen Bot., 1:649, 1840 (published as *Eucliandra*)
Encliandra parviflora ZUCC, Abh Akad. Wiss Muench, 2 335, 1831–1836

Fuchsia parviflora Zucc., l.c , 337; Hemsley, Biol Centr Amer , Bot , 1·460, 1880; Standley, Contr , U S Nat Herb , 23 1080, 1924 Not *F parviflora* Lindl., Bot Reg , 13: 1048, 1827 (see *F thymifolia*)
Kierschlegeria Lindleyi Spach, Ann Sci Nat , (2), 4.176, 1835.

Shrub 1–4 m tall, densely branched, with ultimate branchlets very slender, puberulent, somewhat strigulose and dark colored under the whitish puberulence, leaves mostly opposite, membranaceous, lance-ovate to round-elliptic, entire to inconspicuously serrulate, minutely strigulose to almost glabrous, bicolored, obtusish to acute at both ends, blades 8–15 (20) mm long, 4–10 (15) mm wide, petioles puberulent, 4–8 (12) mm long, flowers solitary, axillary, dioecious or polygamous, pedicels filiform, puberulent, 5–15 mm long, hypanthium cylindrical, strigulose, red, not constricted at base in staminate flowers, 6–8 (10) mm long, 2–3 mm wide, in pistillate flowers constricted above ovary, then 5–7 mm long, 1–2 mm wide, sepals deltoid-ovate, ascending in anthesis, puberulent, reddish, 2 5–3 5 mm long, apiculate, the short tips connivent in the bud, petals suborbicular, 2–3 mm long, reddish, more or less undulate, stamens included, anthers ca 1 5 mm long, style 7–9 mm long, stigma exserted, deeply 4-lobed, berry dark, 7–8 mm thick

Type locality, Mexico Ranging from Hidalgo to Oaxaca, and characterized by its small entire, thin leaves and cylindrical flowers As here understood this species is not nearly so inclusive as determinations on herbarium material would indicate as to previous treatment Material seen, MEXICO, Hidalgo, Zimapán, *Coulter 175* (NY, GH), possible mistake on label Mexico base of Ixtaccihuatl, *Arsène 5539* (MO, US) Morelos, Valle del Tepeite, *Lyonnet 1358b* (US) , Huitzilac, *Lyonnet 1994* (US) , Valle de Cuernavaca, *Lyonnet 735* (NY, US) , kilometer 61, road, Mexico City to Cuernavaca, *Mexia 2718* (F, MICH, GH, CAS, NY, POM, US) , El Parque, *Orcutt 4406* (F, GH) Oaxaca, Sierra de San Felipe, *Pringle 7485* (US), *Nelson 1179* (US) , San Felipe, *Rose and Hough 4605* (US) , Oaxaca, *Conzatti and Gonzales 20* (MO, US) , Reyes, *Nelson 1803* (GH, US) , Yotado, *Galeotti 3068 H* (fragment at F)

(98) **Fuchsia cylindracea** Lindley

(Plate 15, fig 89)

Fuchsia cylindracea Lindl , Bot Reg , 24 66, 1838

Shrub, rather openly branched, up to 5 m high, the ultimate branchlets purplish, subglabrous to sparingly pubescent, the youngest tips more densely but rather coarsely pubescent, rather slender, leaves membranaceous, opposite, obovate to elliptic, subentire, cuneate at base, obtuse to acutish at apex, strongly bicolored, subglabrous to somewhat strigose above, more or less pilose beneath, the blades 2–5 (6 5) cm long, 1–2 (2 5) cm wide; petioles somewhat pilose or pubescent, 3–10 (12) mm long; plants apparently dioecious, flowers solitary axillary, dioecious; pedicels filiform, pubescent, 10–25 mm long, staminate flowers with narrow basal portion, then widened into hypanthium 8–10 mm wide, cylindrical, deep red, somewhat pubescent, sepals ovate-deltoid, 3–3 5 mm long, red, somewhat ascending in anthesis, short-apiculate, the tips connivent in the bud; petals red, suborbicular, more or less apiculate and notched, 3–4 mm. long, stamens included, anthers 1.2–1.4 mm. long; style about 1 mm long, stigma 4-lobed, about 0.5 mm. long, pistillate flowers constricted above the ovary, then expanded into a cylindric hypanthium 4–5 mm long and 2–3 mm. wide, sepals and petals as above, but somewhat smaller, stamens present, the anthers about 0 5 mm. long, not functional?; stigma exserted, 4-lobed, ca. 1 mm long, fruit subglobose, dark, 6–8 mm. thick

Type locality, not known, seed of original plants from Mexico I have seen none of Lindley's herbarium material, but his plate fits well the specimens I refer to this species, with large leaves, long flowers (cylindrical, ½ inch long acc. to Lindley), pubescence, etc The species is near *F Enchandra (parviflora)* but has larger leaves and coarser hair; there is some intergradation, as *Ghiesbreght 696* (MO) from Chiapas with leaves of *cylindracea* and flowers of *Enchandra; "F pubescens," Sessé and Mociño 5215* (F) Representative of *cylindracea* may be cited, MEXICO, without locality, *Coulter 174* (GH, NY) Mexico, District of Temascaltepec, Timbres, *Hinton 3055* (US), Cajones, *Hinton 4044* (US) Michoacán, Campanario near Morelia, *Arsène 5665* (NY, US), *6523* (US), *Arsène in 1910* (F), Pátzcuaro, *Pringle 4266* (F, GH, MICH, NY, US), *3583* (F) Oaxaca, 18 miles s w of Oaxaca City, *Nelson 1391* (US)

(99) **Fuchsia tetradactyla** Lindley

(Plate 15, fig. 90)

Fuchsia tetradactyla Lindl., Journ Hort. Soc, 1·304, 1846.
F Seleriana Loesener, Verh Bot Ver Brandenb, 55 179, 1913, Standley and Steyermark, Field Mus. Nat Hist., Bot., 22·363, 1940.

Shrub 6–15 (24) dm tall, openly branched, the ultimate branchlets reddish, 1–2 mm thick, puberulent, more or less strigulose, leaves opposite or nearly so, broadly ovate, somewhat rhomboid, membranaceous, not crowded, subentire or remotely denticulate, soft pubescent on both surfaces, bicolored, rounded to broad-cuneate at base, abruptly acute to obtuse at apex, the blades 2–6 (10) cm long, 1 5–5 cm wide, with about 6 pairs of lateral veins; petioles slender, 1.5–3 (4) cm long; flowers solitary, axillary, the plants dioecious, pedicels filiform, strigulose to pubescent, 1–1 8 cm long; staminate flowers with hypanthium subcylindric, 7–10 mm long, 2 5–3 5 mm wide, puberulent, rose-orchid to deep red; sepals red to orchid, puberulent, 2.5–3 (4) mm. long, ascending, deltoid, apiculate, the tips about 0.5 mm long, somewhat separate in bud; petals rose-scarlet or paler, suborbicular, ca 3 mm long; stamens included, anthers 2 mm long; stigma included, pistillate flowers smaller, constricted above ovary; hypanthium 5–6 mm. long, 1–2 mm. wide, anthers less than 1 mm long, style 8–9 mm. long, stigma exserted, 4-lobed, 1 mm. long, fruit purplish or black, up to 1 cm thick.

Type locality "Guatemala," type collected by G. W Skinner, April 4, 1846. I have not seen the type, but am taking the name *tetradactyla* for the plant recently called *Seleriana* The large leaves (2.7 inches long, including petioles), the calyx (½ inch long, that is hypanthium plus sepals), pedicels equaling petioles, and origin Guatemala, all these points mentioned in the original description can indicate only this species Material seen, MEXICO, without definite locality, "*Fuchsia tomentosa* N ," *Sessé, Mociño, et al. 5207* (F). Oaxaca, between Suchistepec and Miahuatlán, *Nelson 2515* (US); between Plunia and San Miguel Suchistepec, *Nelson 2505* (US). Chiapas, Teopisca, *Goldman 970* (US) GUATEMALA Baja Vera Paz, Santa Rosa, *von Tuerckheim* under *J D. Smith 1315* (US). Quezaltenango, Volcán Zunil, *Steyermark 34741* (F); near Quezaltenango, *Seler 2894,* type of *Seleriana* (photos F, POM, specimen CAS), Quezaltenango, *Skutch 810* (F, NY), Volcán de Santa María,*Steyermark 34031* (F, POM) Chimaltenango, Tecpám, *Johnston 761a* (F), *Skutch 489* (F, GH, MICH, US) Sacatepéquez, Santa Lucia, *Popenoe 689* (US), Volcán de Acatenango, *Shannon under J. D Smith 3656* (US); Finca El Hato, ne of Antigua, *Standley 61202* (F), Santiago, *Gomez under J D Smith 872* (US) Guatemala, Carmela, *Morales 1100* (F) Jalapa, Cerro Alcoba, *Steyermark 32512* (F, POM) Zacapa, Sierra de las Minas, *Steyermark 29704* (F)

(100) **Fuchsia Mexiae** Munz,, new species

(Plate 15, fig 91)

Leafy shrub apparently rather large, ultimate twigs very slender, somewhat reddish, somewhat fine-pubescent, leaves opposite, petioles slender, pubescent, 7–20 (25) mm long, leaf-blades membranaceous, rhomboid-ovate to -obovate, bicolored, acute to acuminate at both ends, remotely sinuate-serrulate, subglabrous to minutely puberulent on both surfaces, especially on the veins and margins, 1 5–4 (4 5) cm long, 1–2 cm wide, flowers reddish, axillary, dioecious, pedicels filiform, strigulose, about 1 cm long, hypanthium of pistillate flowers tubular, strigulose, 3–4 5 mm long, barely 1 mm. wide, sepals ovate, 1 5–2 mm long, petals white, rounded, ca 1 mm long, style 5–6 mm long; stigma deeply 4-lobed, well exserted, ca. 1 mm long; staminate flowers not seen, but undoubtedly larger, fruit dark, 5–7 mm thick

Frutex foliosus, ramulis tenuibus, rubescentibus, puberulentis; foliis oppositis, petiolis tenuibus, pubescentibus, 7–20 (25) mm. longis; laminis membranaceis, rhomboideo-ovatis vel -obovatis, acutis vel acuminatis in extremis utrisque, remote sinuato serrulatis, subglabris vel puberulentis in superficiebus utrisque, 1.5–4 cm. longis, 1–2 cm. latis, floribus rubescentibus, in axillis solitariis; pedicelis filiformibus, strigulosis, 1 cm. longis, hypanthio florium pistillatorum tubuloso, striguloso, 3–4.5 mm. longo, 1 mm. lato, sepalis ovatis, 1.5–2 mm. longis; petalis albis, orbiculatis, 1 mm. longis; stylo 5–6 mm. longo; stigmate 4-lobato, exserto, 1 mm. longo; floribus staminatis incognitis; fructu nigro, 5–7 mm. crassi.

Type: from open dry pine forest, at 1500 m., Cañon El Ranchito, San Sebastian, Jalisco, Mexico, Jan. 12, 1927, *Ynez Mexia 1465,* U S Herbarium no. 1319484; isotypes F, GH, CAS, MICH, NY Another collection is from Morelos, El Parque, *Rose and Rose 11118* (NY, US). The proposed species is much like *F striolata,* but has membranaceous leaves, more rhomboid leaf-blades, white petals, and more western range.

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The number given after each name refers to the species number used in this paper

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  microphylla Spach, see 93a
  thymifolia Steud , see 85
Dorvalla eucharis Comm., see 3a
Ellobium Lilja, see Sect 2, *Eufuchsia.*
  fulgens Lilja, see 47
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  acynifolia Scheidw in Otto and Dietr , Allg Gartenz , 15 226, 1847 I have seen no material so labeled, no type number was designated It was said to have come from Mexico and the characters mentioned (small ovate leaves dentate toward the tips, calyx cylindrical, 6 lines long, leaves with some puberulence above, glabrous beneath, pedicels short) suggest *F. microphylla* H B K , no 93
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  amoena Hort , mentioned in DC Prodr , 3 37, 1828 a synonym of *F arborescens.*
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perbrevis Johnston, see 51.
perscandens Cockayne and Allan, no. 69
peruviana Carr. in Johnston, Contr. Gray Herb., 75: 39, 1925, apparently a slip for *F. boliviana*
Fuchsia petiolaris H.B.K., no. 24
  var. *bolivarensis* Munz, no. 24b.
  var. *typica* Munz, no. 24a
pilosa Field and Gardn., no. 60.
platypetala Johnston, no. 19.
polyantha Killip, no. 41.
polyanthella Johnston, see 58
Pringlei Robinson and Seaton, no. 86.
Pringsheimii Urb., no. 22
procumbens Cunn., no. 70
prostrata Baill., see 70
pubescens Cambess., see 4
pubescens R. and P., in Field Mus. Nat. Hist., Bot., 21: 212, 1940, *nomen nudum*.
pulchella Woodson and Seibert, see 94
pumila Hort. ex Muenissier, Rév. Hort., n. s. 20: 173, 1926; horticultural.
pumila Hort. ex Vilmorin, Blumeng., ed. 3, Sieb. and Voss, 1: 332, 1894, in synonymy under *F. gracilis* f. *pumila* Voss.
punicea R. and P., Field Mus. Nat. Hist., Bot., 21: 212, 1940, *nomen nudum*.
putumayensis Munz, no. 56.
pyrifolia Presl, see 6b.
quinduensis H.B.K., see 24a.
racemosa Lam., Encyc. 2: 565, 1788; pl. 282, fig. 1, 1793. Given with *F. triphylla* as synonym, but as coming from Cartagena, Colombia. It may be an earlier name for *F. petiolaris*, but I have not had access to a specimen since I discovered that fact.
racemosa Sessé and Moc., Pl. N. Hispan., ed. 1, 58, 1887–'90. Description given suggests *F. fulgens*, although it was referred to *F. arborescens* by G. Don, Gen. Syst., 2: 677, 1832. Leaf at Field (ex herbario Musei Parisiensis) labeled "*F. racemosa* Lam." can well be *F. fulgens* in size, veins, pubescence.
radicans Miers, see 6b
Fuchsia recurvata Niven, see 3b
regia (Vell.) Munz, no. 6
  var. *affinis* Munz, no. 6c
  var. *alpestris* Munz, no. 6d
  var. *radicans* Munz, no. 6b
  var. *typica* Munz, no. 6a.
Riccartonensis Bergmans, Vaste Pl. Rotsheesters, 227, 1924; see *F. Riccartonii*
Riccartoni Hort. ex Tillery, in Flor. and Pom., 217, 1871, horticultural name with inadequate description.
Riccartoniana Hort. ex Koehne, Deutsche Dendrol., 429, 1893, horticultural name.
rivularis Macbr., no. 15.
robusta Tengbergen, Tuinb. Fl., 2: 345, 1855, hybrid.
rosea R. and P., see 65
  var. *spinosa* Reiche, see 65.
salicifolia Hemsl., no. 76
sanctae rosae Kuntze, no. 52
scabriuscula Benth., no. 50.
scandens Krause, see 48
Scherffiana André, Rev. Hort., 1888: 232 and 268, from Ecuador; would seem nearest to *F. Townsendii* Johnston, over which it has priority, but the description sounds as if it had narrower petals. I have not seen type material.
Seleriana Loes., see 99.
semperflorens Rosain, Wien. Illustr. Gartenz., 1888: 244; hybrid.
serratifolia R. and P., see 10.
serratifolia Hook., see 9.
sessilifolia Benth., no. 63.
simplicicaulis R. and P., no. 31.
siphonantha Krause, see 11.

  Skutchiana Munz, no 90.
  Smithii Munz, no 25.
Fuchsia speciosa Hort, see 5
  spectabilis Hook, see 20a
    var *pubens* Johnston, see 20b.
  spinosa Presl, see 65.
  splendens Zucc, no. 7
  Standishii Paxton, Bot Mag., 11·33, 1844, garden hybrid.
  Steinbachii Johnston, see 74
  Storkii Munz, no 37
  striolata Lundell, no. 95.
  sylvatica Benth, no 64
  syringaeflora Carr., see 84a.
  tacanensis Lundell, no 89
  tacsoniiflora Krause, see 10
  tenella Hort, see 3a.
  tetradactyla Lindl, no. 99
  Thompsoni Hort ex Koehne, Deutsche Dendrol, 430, 1893; *nomen nudum*. No description, 3 varieties figured.
  thymifolia H B K, no. 85
  tincta Johnston, no. 34
  Townsendii Johnston, no. 18
  triphylla L., no 23
  tuberosa Krause, no 73
    var *inflata* Munz, no 73b
    var *typica* Munz, no 73a.
  tunariensis Kuntze, no 77
  umbrosa Benth., see 16
  unduavensis Munz, no 80
  uniflora Sessé and Moc., Pl. N Hispan, ed 1, 58, 1887–'90. Unknown to me.
  velutina Johnston, see 42
  venusta H.B K, no 28
    var *huilensis* Munz, no 28b.
    var. *typica* Munz, no 28a.
Fuchsia verrucosa Hartw., no. 51.
  verticillata R. and P., in Field Mus. Nat. Hist., Bot., 21:46, 1940; *nomen nudum*.
  violacea R. and P., in Field Mus. Nat Hist, Bot., 21·128, 1940; *nomen nudum*.
  virgata Sweet, Hort Brit, ed 1, 485, 1827; *nomen nudum*
  vulcanica André, see 14
  Weberbaueri Krause, see 52.
  Woytkowskii Macbr', no 12.
Kierschlegeria Spach, section no. 3
  Lindleyi Spach, see 97
  lycioides Spach, see 65
Lopezia thymifolia Willd., see 85
Lyciopsis Spach, see *Encliandra*, sect. 7
  thymifolia Spach, see 85
Myrinia Lilja, see *Encliandra*, sect. 7
  microphylla Lilja, see 93a
Nahusia Schneev, see *Quelusia*, sect. 1
  coccinea Schneev, see 4
Quelusia Vandelli, section no. 1.
  regia Vand, see 6
Schufia Spach, section no 6
  arborescens Spach, see 84a
Skinnera Forst, section no 4
  antartica Forst said to be *Blackwellia antartica* Gaertn
  coccinea Moench, see 4
  excorticata Forst, see 66.
Spachia Lilja, in Traedgardtidning, 62, 1840, ex Linnaea, 15.262, 1841. No species named, synonym of *Fuchsia*.
Thilcum (or *Thileum*?) Molina, see *Nahusia*, sect 1
  tinctorium Molina, see 3b.
Tilco Adans, Fam 2 498, 1763, no species named, synonym of *Fuchsia*, acc to Kew Index

EXPLANATION OF PLATES

Measurements given for flower are from base of ovary to tip of stigma, for leaf include petiole and blade

PLATE 1

Fig 1 F *Campos Portoi*, drawn from Brade 15676, flower 32 mm , leaf 27 mm
Fig 2 F *Bracelinae*, drawn from Mexia 4013, flower 42 mm , leaf 45 mm
Fig 3 F *magellanica*, from Werdermann 61, flower 56 mm , leaf 53 mm
Fig 4 F *coccinea*, from Hoehne 6278, flower 41 mm , leaf 41 mm
Fig 5 F *regia*, from Regnell 794, flower 62 mm , leaf 66 mm
Fig 6 F *splendens*, from Standley 61808, flower 60 mm , leaf 80 mm
Fig 7 F *cordifolia*, from Skutch 867, flower 83 mm , leaf 120 mm
Fig 8 F *austromontana*, from Pennell 14110, flower 56 mm , leaf 104 mm

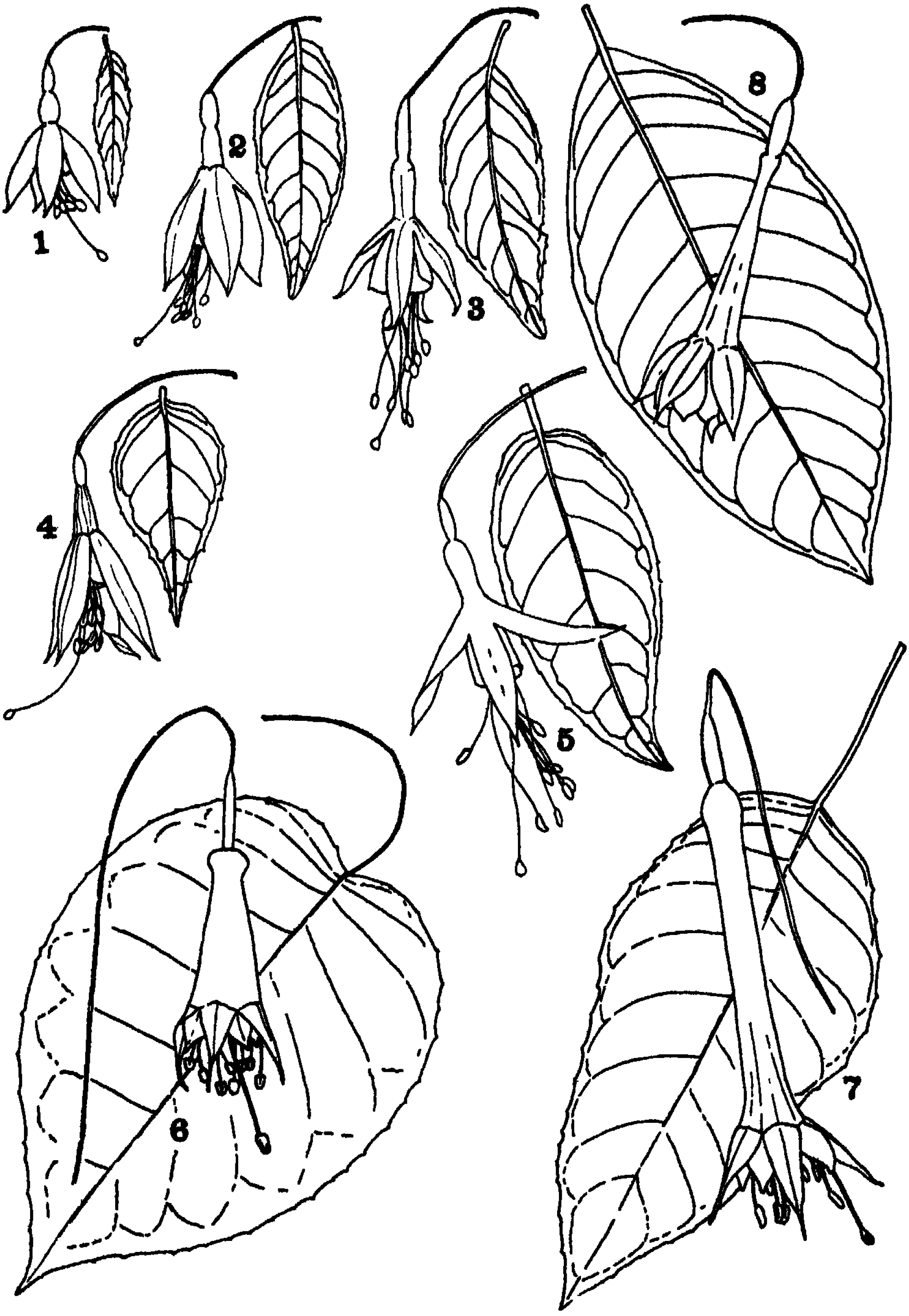
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PLATE 2

Fig 9. *F. denticulata*, from Weberbauer 7587, flower 72 mm, leaf 103 mm

Fig 10 *F. leptopoda*, from Weberbauer 6934, flower 80 mm, leaf 107 mm

Fig 11 *F Woytkowskii*, from Woytkowski coll, flower 58 mm.; leaf 73 mm

Fig 12 *F. magdalenae*, from Seifriz 392; flower 95 mm, leaf 65 mm

Fig 13. *F. canescens*, from Penland 623, flower 80 mm; leaf 55 mm

Fig 14 *F. loxensis*, from Penland 959; flower 30 mm., leaf 68 mm.

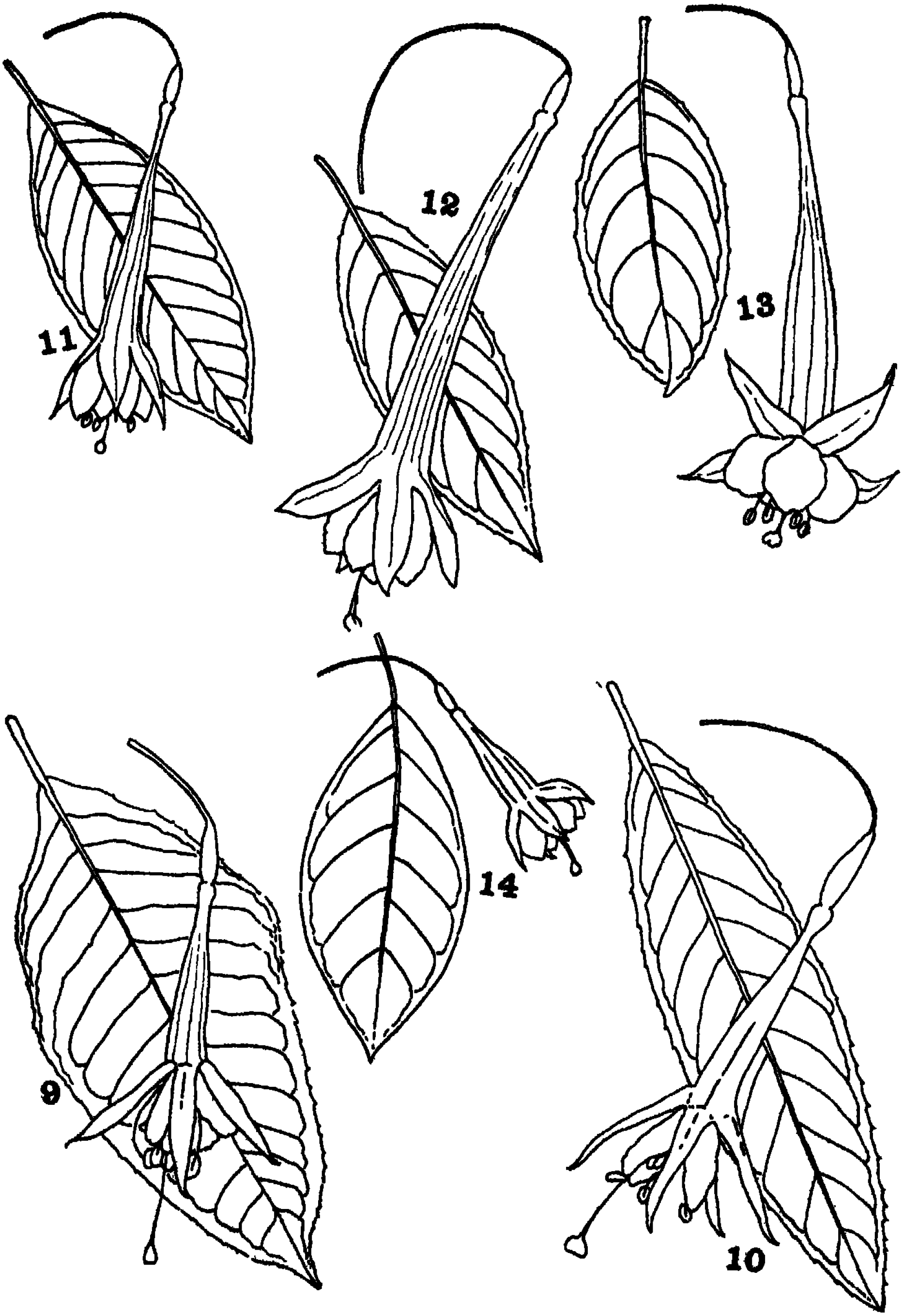
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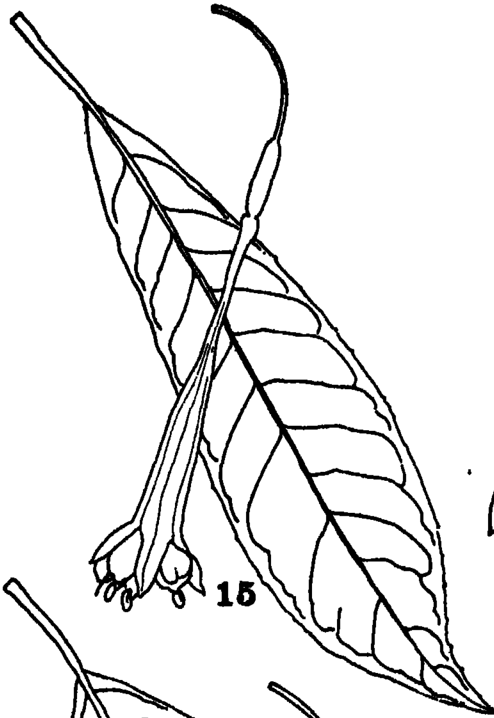
PLATE 3

Fig 15 *F Townsendii*, from Townsend A93, flower 75 mm., leaf 128 mm

Fig 16 *F platypetala*, from West 3705; flower 78 mm, leaf 91 mm

Fig 17 *F macrostigma*, from Rose 22479, flower 83 mm, leaf 145 mm

Fig 18 *F ayavacensis*, do not have record of specimen, flower 56 mm, leaf 95 mm



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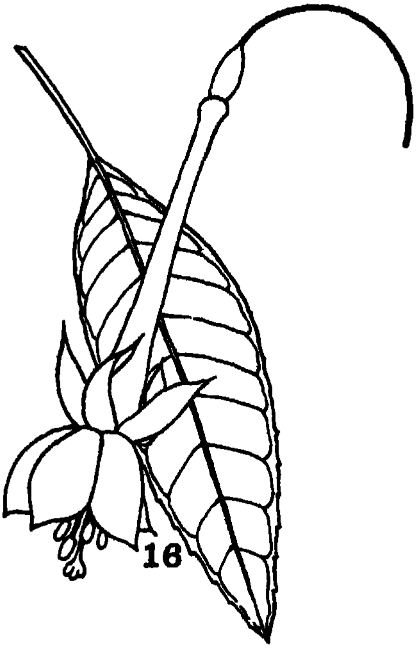

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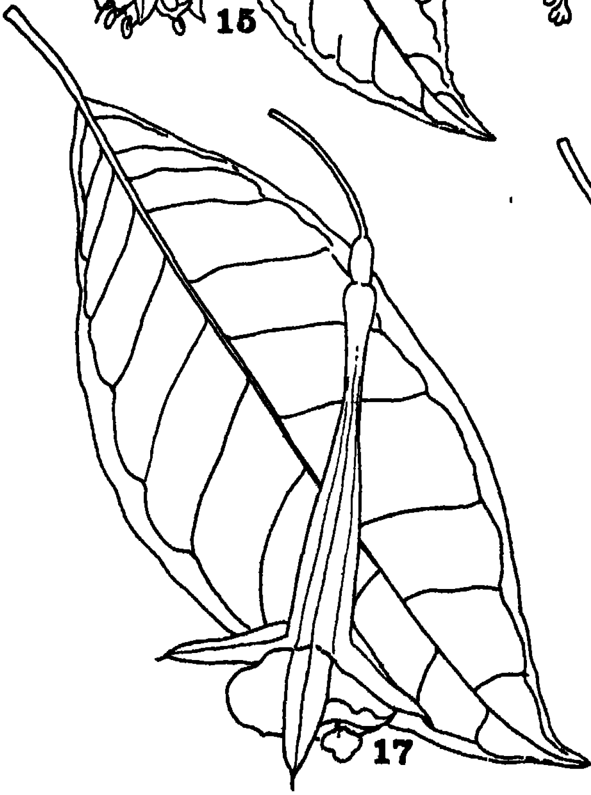

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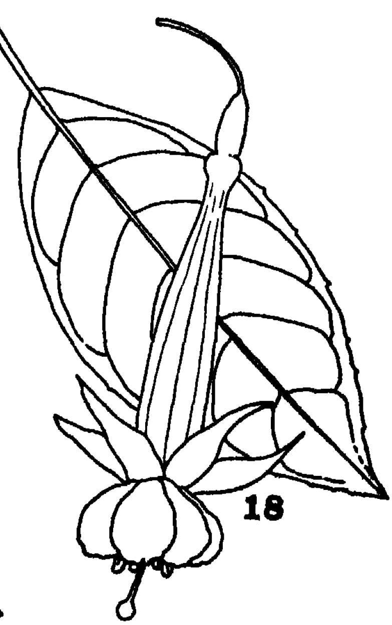

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PLATE 4

Fig 19 *F Pringsheimii*, from von Tuerckheim 3151, flower 65 mm , leaf 25 mm

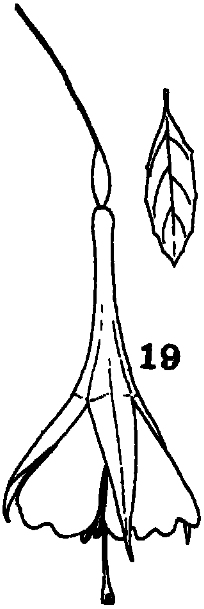
Fig 20 *F triphylla*, from Leonard 3681, flower 50 mm , leaf 70 mm

Fig 21 *F petiolaris*, from Pennell 2379, flower 69 mm , leaf 57 mm

Fig 22 *F petiolaris* var *bolivarensis*, from Pennell 4324, flower 80 mm ; leaf 76 mm

Fig 23 *F Smithii*, from Killip and Smith 17300, flower 75 mm , leaf 57 mm

Fig 24 *F Asplundii*, from Weberbauer 6054, flower 63 mm , leaf 75 mm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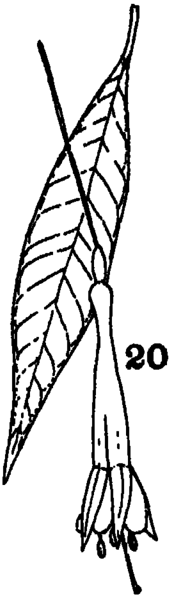
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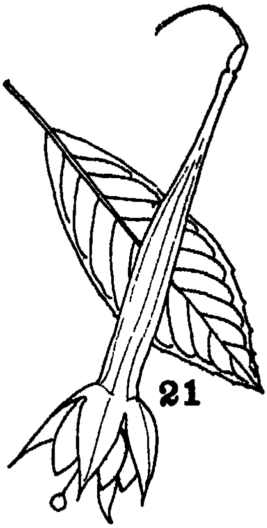
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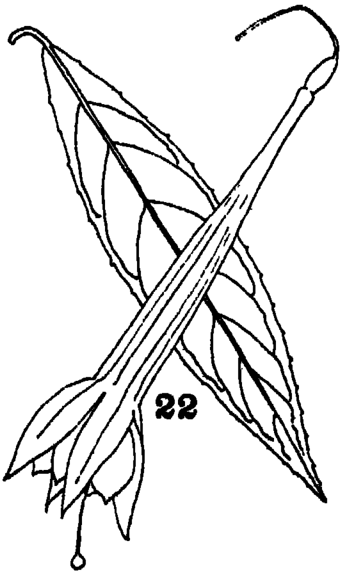
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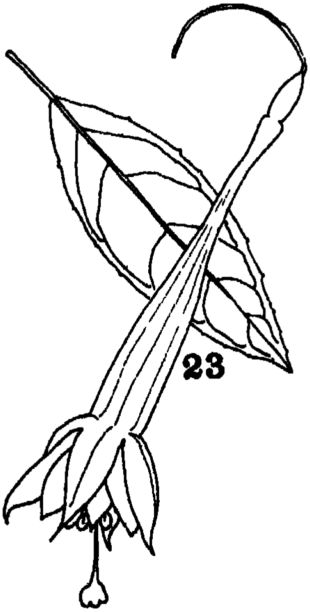
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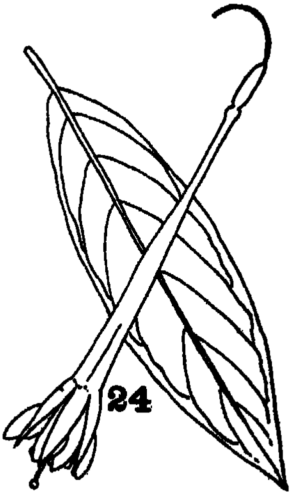
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PLATE 5

Fig 25 *F Llewelynii*, from Llewelyn Williams 7594, flower 68 mm , leaf 87 mm

Fig 26 *F venusta*, no record of specimen from which drawn, flower 62 mm , leaf 125 mm

Fig 27 *F Jahnii*, from Jahn 506, flower 60 mm , leaf 71 mm

Fig 28 *F Gehrigeri*, from Gehriger 322, flower 62 mm , leaf 80 mm.

Fig 29 *F simplicicaulis*, from Macbride 4014, flower 68 mm , leaf 141 mm

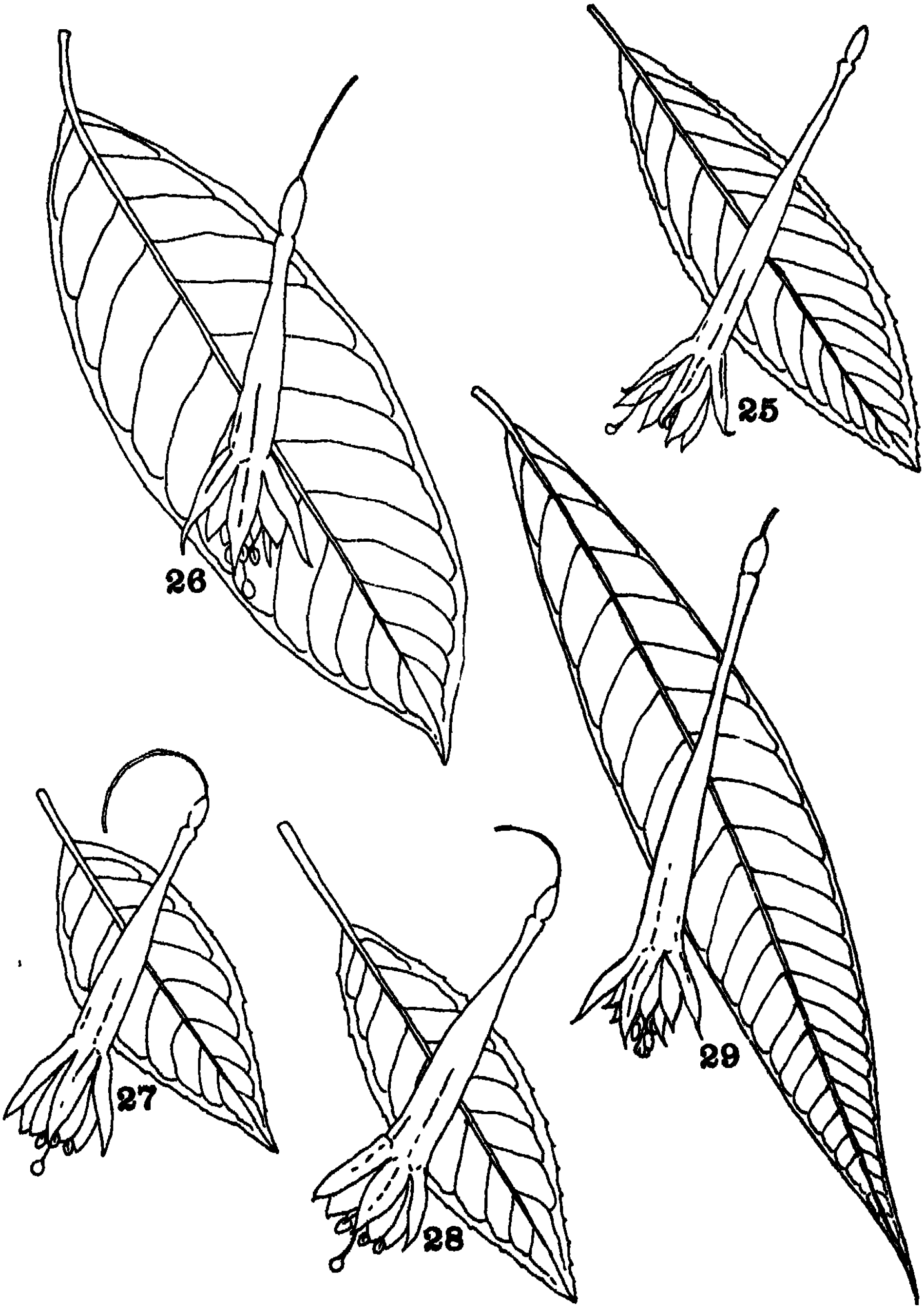


PLATE 6

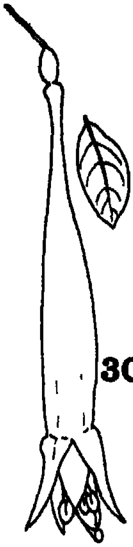
Fig 30 F *confertifolia*, from Weberbauer 7153, flower 74 mm , leaf 17 mm.

Fig 31 F *Aspiazui*, from Weberbauer 7042, flower 78 mm , leaf 133 mm

Fig 32 F *tincta*, from West 7092, flower 44 mm , leaf 134 mm

Fig 33 F *Storkii*, from Stork 10073, flower 41 mm , leaf 75 mm

Fig 34 F *furfuracea*, from Bang 674, flower 68 mm , leaf 100 mm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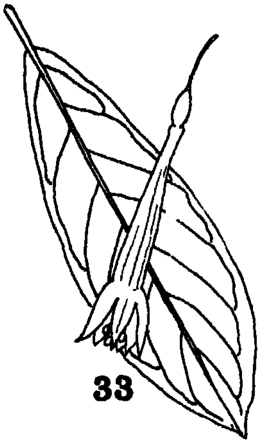
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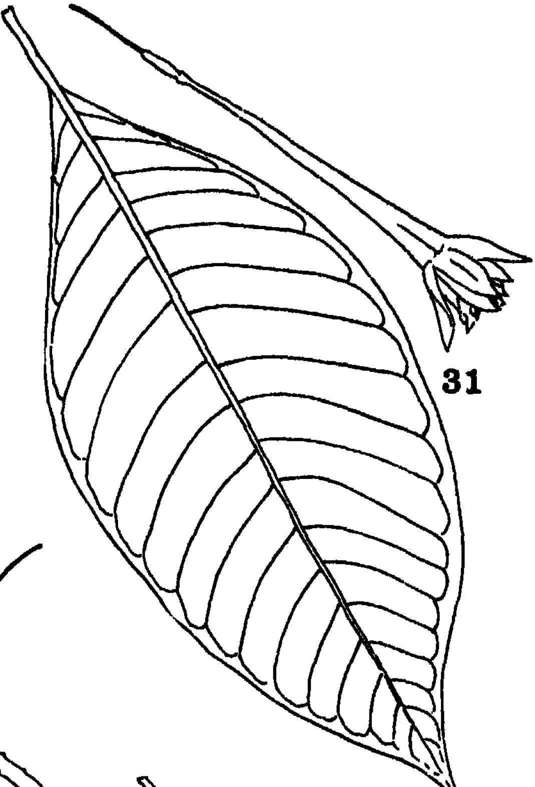
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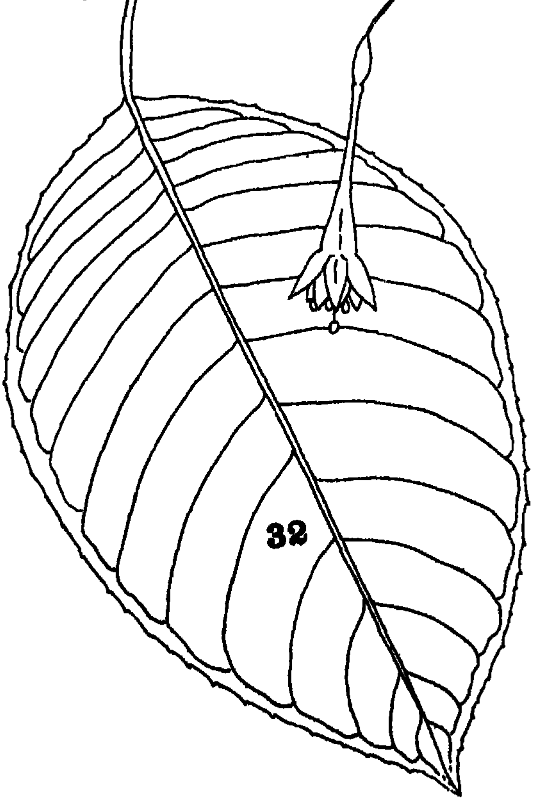
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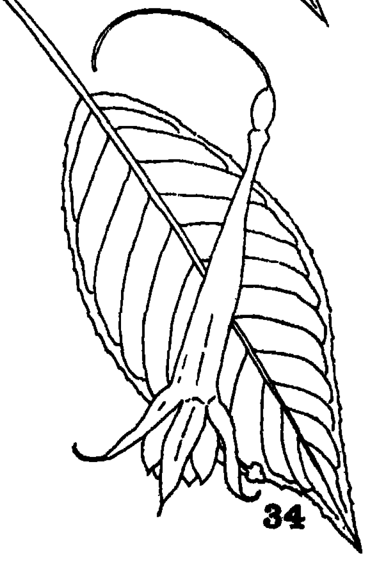
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PLATE 7

Fig 35 *F Munzii,* from Weberbauer 6648, flower 52 mm , leaf 115 mm

Fig 36 *F hirtella,* from Cuatrecasas 6657, flower 64 mm , leaf 125 mm

Fig 37 *F polyantha,* from Mexia 7571, flower 55 mm , leaf 69 mm

Fig 38 *F corymbiflora,* from Mexia 7765, flower 68 mm , leaf 148 mm

Fig 39 *F abrupta,* from Macbride 4541, flower 58 mm , leaf 116 mm

Fig 40 *F Cuatrecasasii,* from Cuatrecasas 8738, flower 47 mm , leaf 84 mm

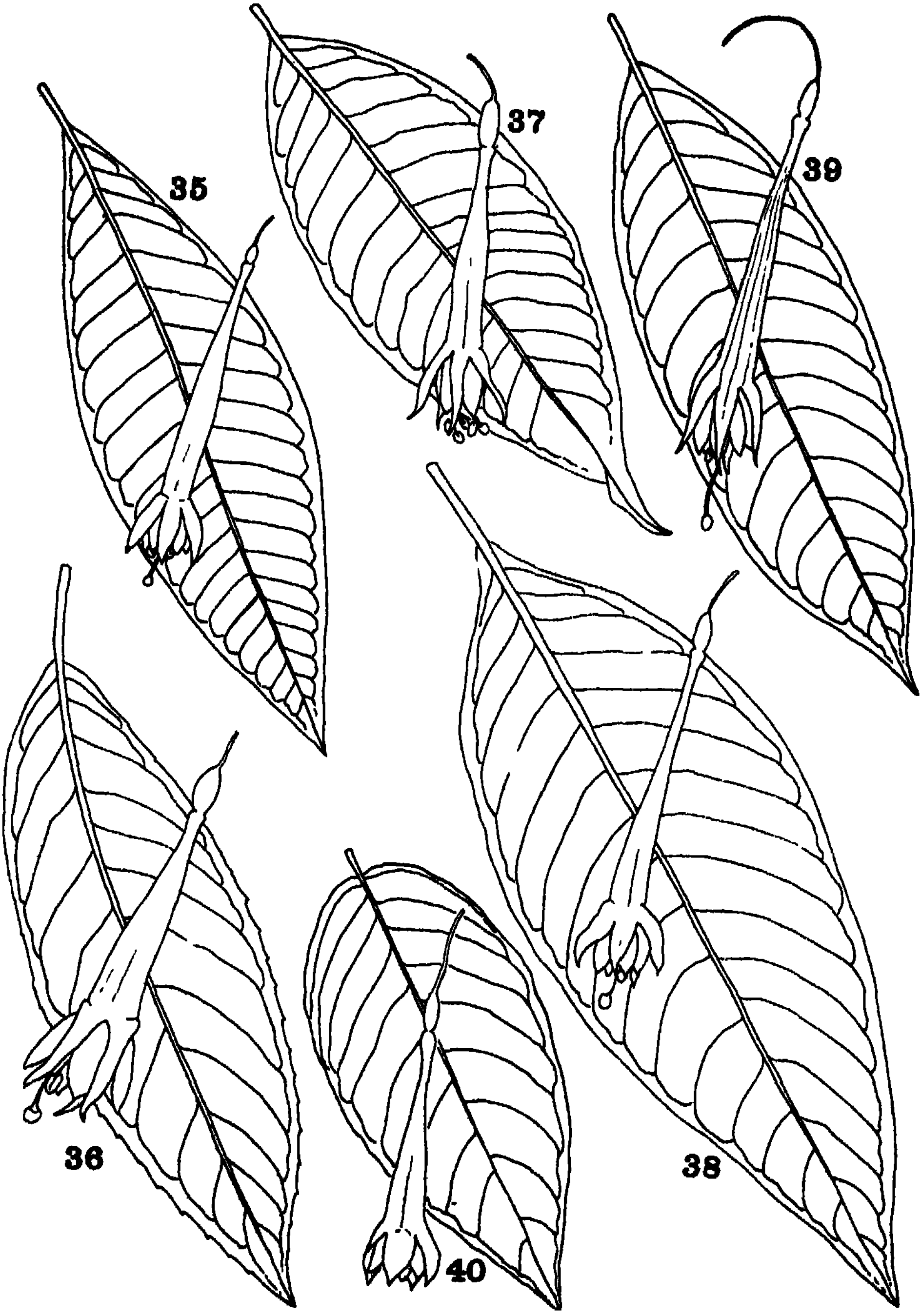
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PLATE 8

Fig 41 *F Killipii,* from Killip 16695; flower 62 mm , leaf 102 mm

Fig 42 *F boliviana,* from Balls 6715, flower 84 mm , leaf 140 mm

Fig 43 *F fulgens,* from Pringle 4123, flower 150 mm , leaf 180 mm

Fig 44, *F decussata,* from Macbride and Featherstone 2124, flower 28 mm , leaf 65 mm

Fig 45 *F hypoleuca,* from Hitchcock 21440, flower 42 mm , leaf 70 mm

Fig 46 *F scabriuscula,* from unknown source, flower 45 mm , leaf 106 mm

Fig 47 *F verrucosa,* from Cuatrecasas 8465, flower 24 mm , leaf 65 mm

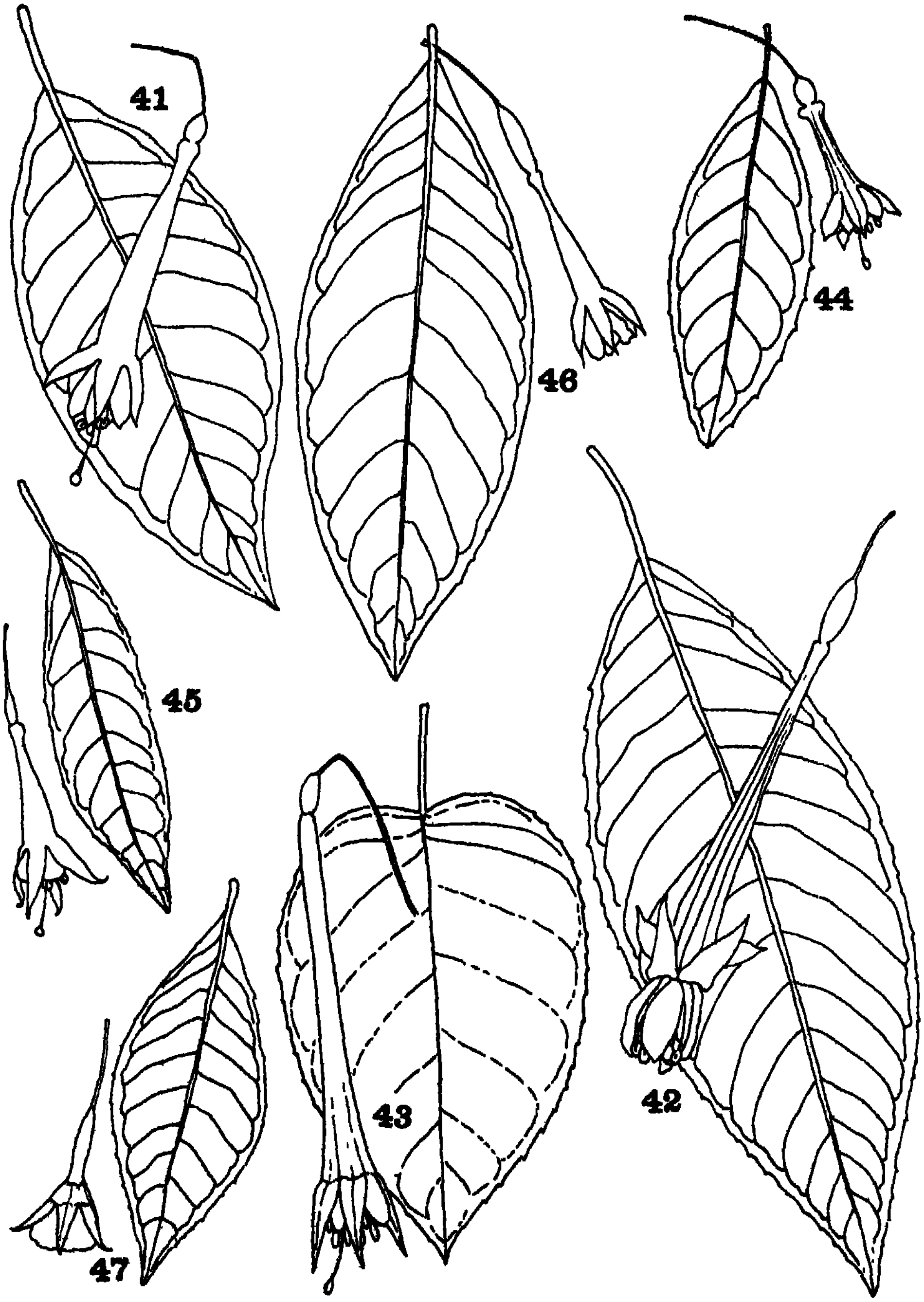
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PLATE 9

Fig 48 *F sanctae rosae,* from West 6414, flower 40 mm.; leaf 96 mm

Fig 49 *F Osgoodii,* from Osgood and Anderson 47, flower 38 mm , leaf 99 mm

Fig 50 *F Andrei,* from André K 820, flower 45 mm , leaf 122 mm

Fig 51 *F Lehmannii,* from Lehmann 5498; flower 35 mm , leaf 140 mm

Fig 52 *F putumayensis,* from Garcia 4639, flower 28 mm , leaf 91 mm

Fig 53 *F Hartwegii,* from Killip 6829, flower 37 mm , leaf 130 mm

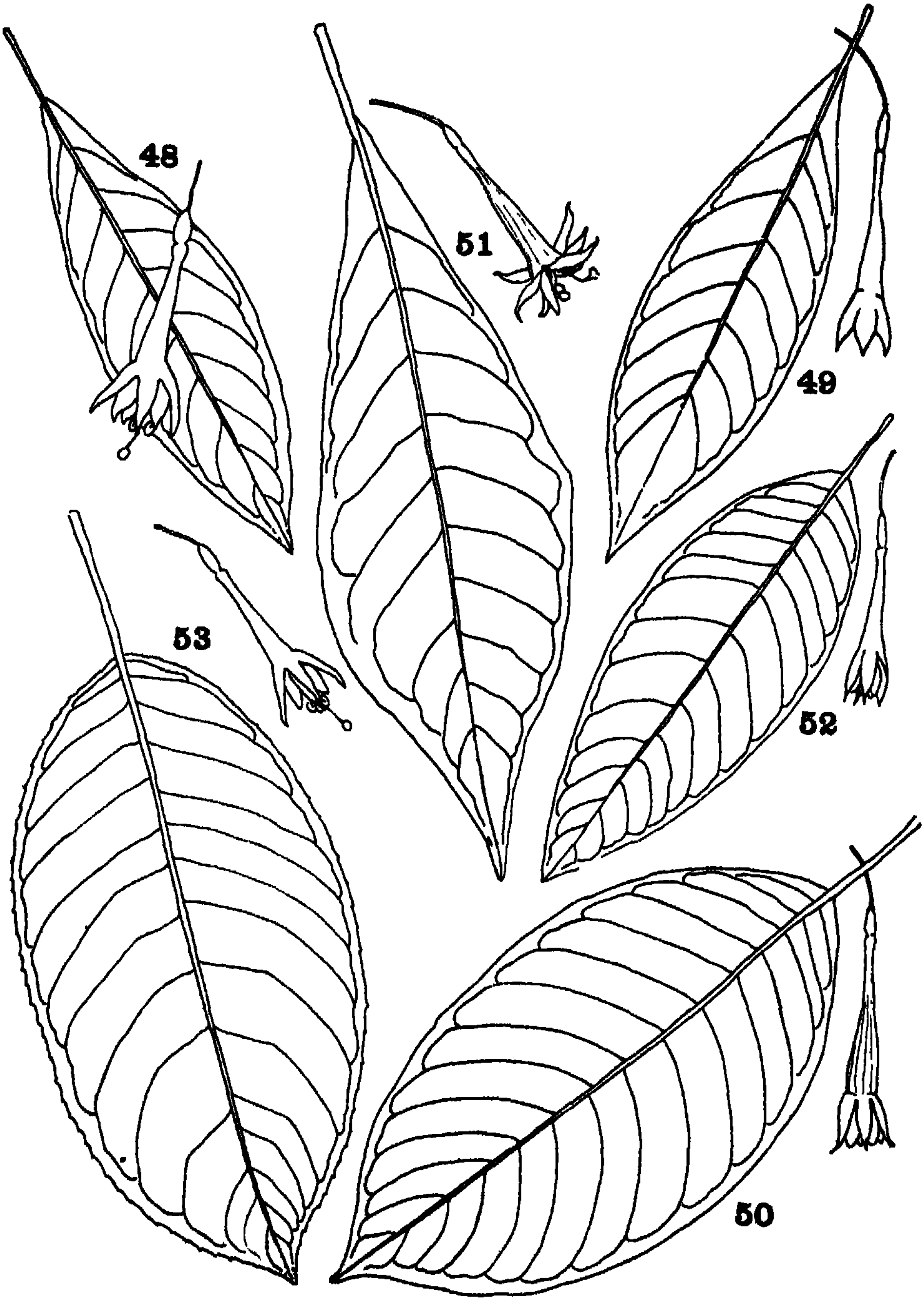

PLATE 10

Fig 54 *F ovalis*, **from Weberbauer 6721, flower 24 mm , leaf 189 mm**

Fig 55 *F glaberrima*, **from Hitchcock 21750, flower 42 mm , leaf 161 mm**

Fig 56 *F macrophylla*, **from Macbride 5616, flower 31 mm , leaf 225 mm.**

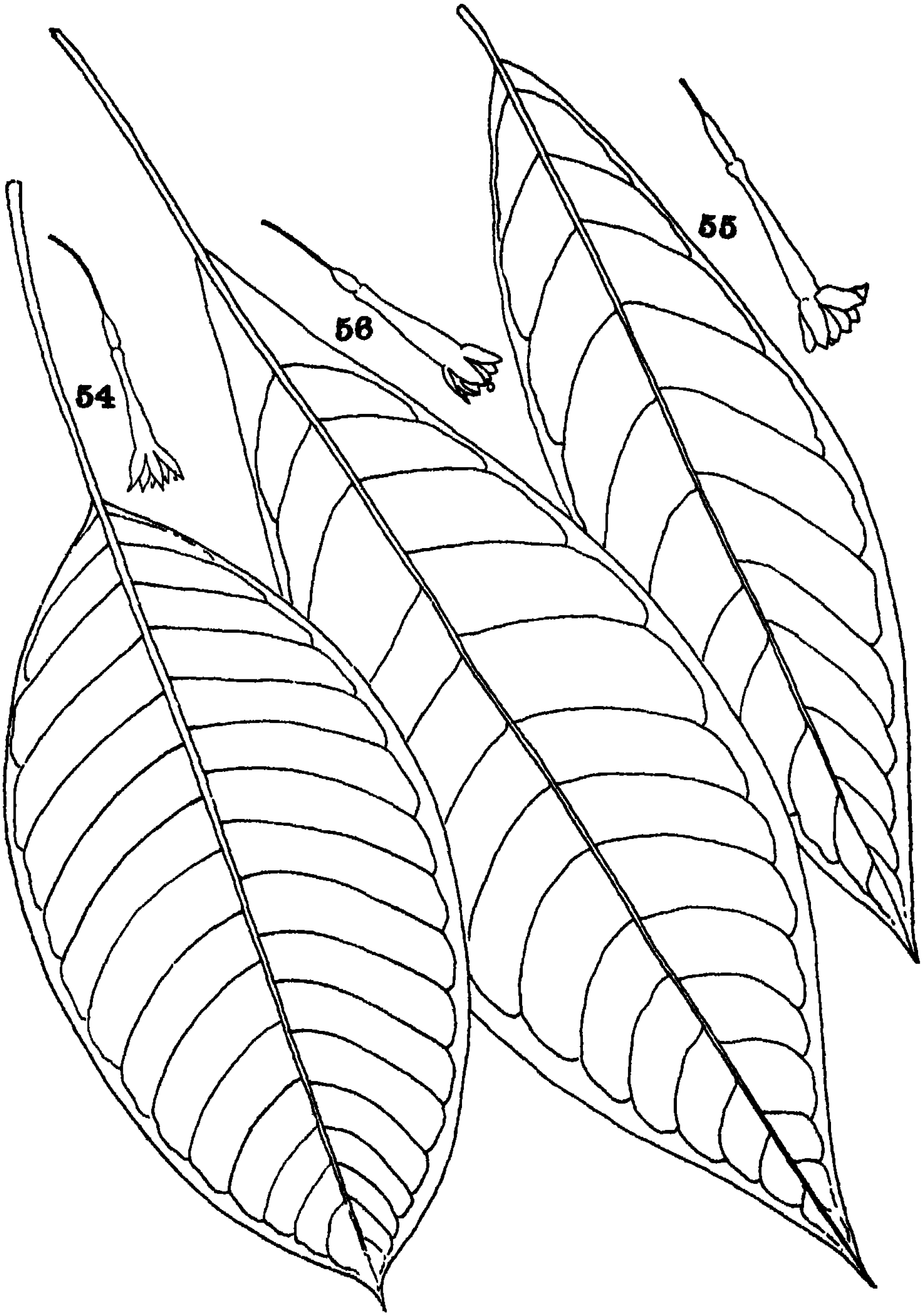
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PLATE 11

Fig 57 *F sessilifolia*, from Mexia 7597, flower 30 mm, leaf 138 mm.

Fig 58 *F sylvatica*, from Dawe 769, flower 42 mm, leaf 131 mm

Fig 59 *F lycioides*, from Garaventa 1641, flower 14 mm, leaf 26 mm

Fig 60 *F excorticata*, from Petrie 4110, flower 40 mm, leaf 95 mm

Fig 61 *F cyrtandroides*, from MacDaniels in 1927, flower 34 mm, leaf 130 mm

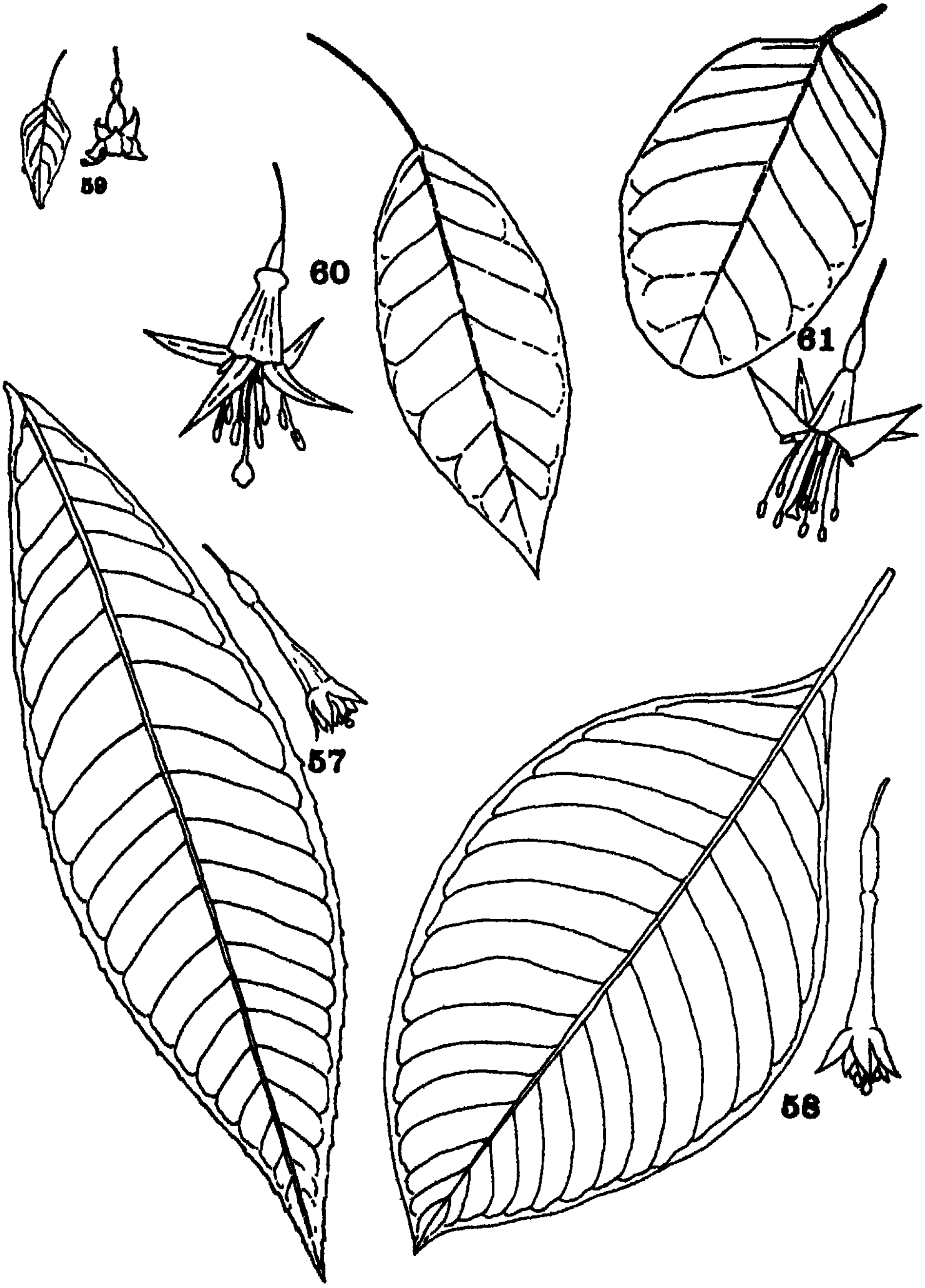
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PLATE 12

Fig 62 *F. Colensoi*, from Petrie 4109, flower 28 mm , leaf 48 mm

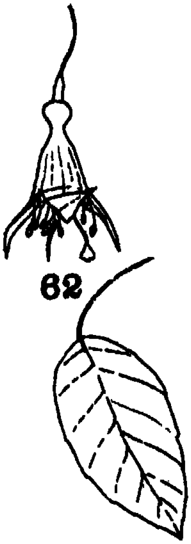
Fig 63 *F perscandens*, from Allan in 1924, flower 82 mm , leaf 38 mm

Fig 64 *F procumbens*, from Meebold 25160, flower 17 mm , leaf 40 mm

Fig 65 *F decidua*, from Mexia 1601, flower 45 mm

Fig 66 *F tuberosa*, from Pennell 13973, flower 82 mm , leaf 135 mm

Fig 67 *F juntasensis*, from Steinbach 5038, flower 82 mm , leaf 91 mm



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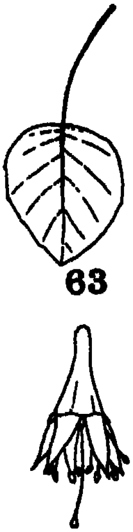

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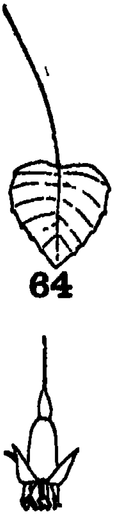

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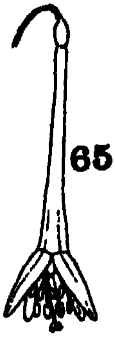

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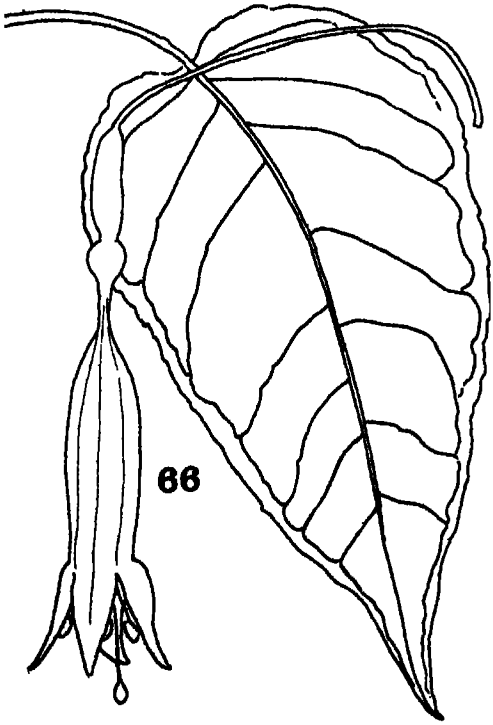

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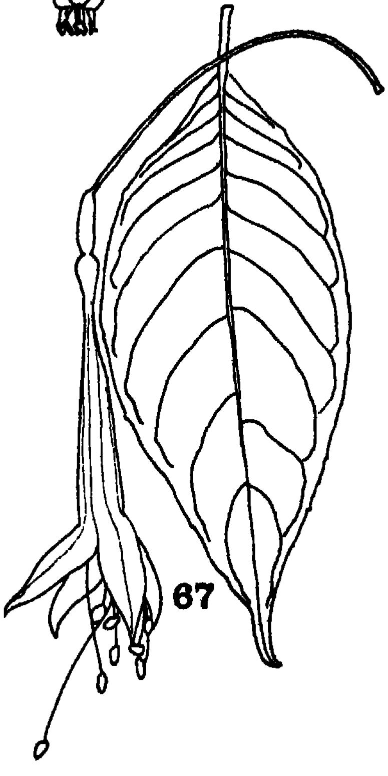

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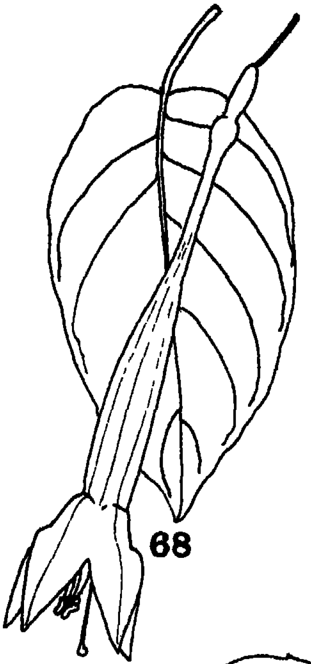
PLATE 13

Fig 68 *F tunariensis,* from Cárdenas 3369, flower 91 mm, leaf 76 mm.

Fig 69 *F apetala,* from Hitchcock 21701, flower 72 mm, leaf 108 mm and from Rose 22230

Fig 70 *F. hirsuta,* from Weberbauer 6975, flower 67 mm, leaf 131 mm

Fig 71 *F unduavensis,* from Buchtien 2925; flower 80 mm; leaf 88 mm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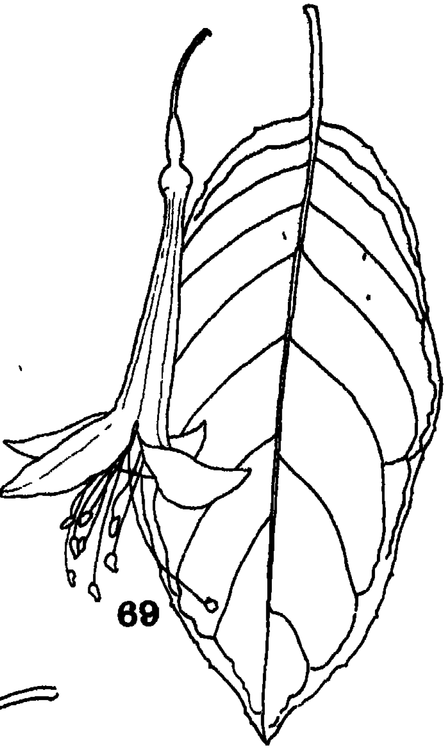
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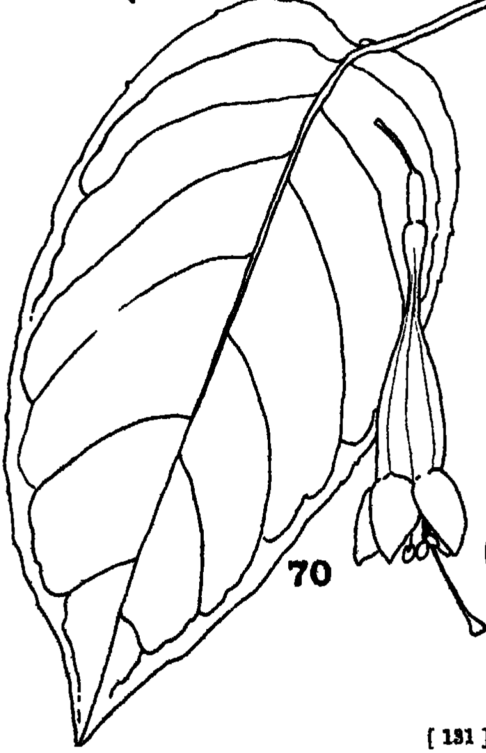
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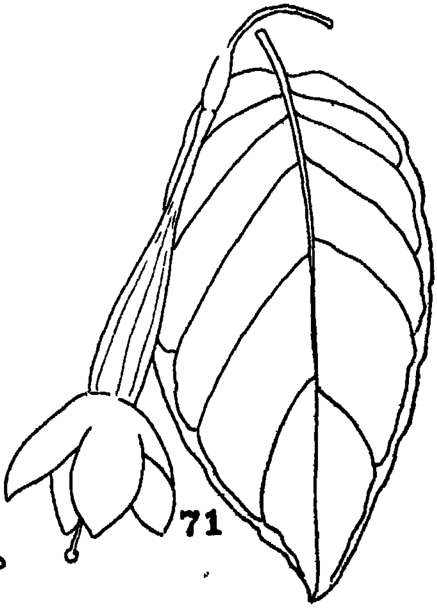
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PLATE 14

Fig 72 *F Garleppiana,* from Cárdenas 688, flower 152 mm , leaf 153 mm

Fig 73 *F macrantha,* from Cook and Gilbert 1312; flower 136 mm , leaf 87 mm.

Fig 74 *F cestroides,* from Weberbauer 6423, flower 35 mm., leaf 111 mm

Fig. 75 *F arborescens* var *typica,* from Skutch 59, flower 15 mm , leaf 125 mm

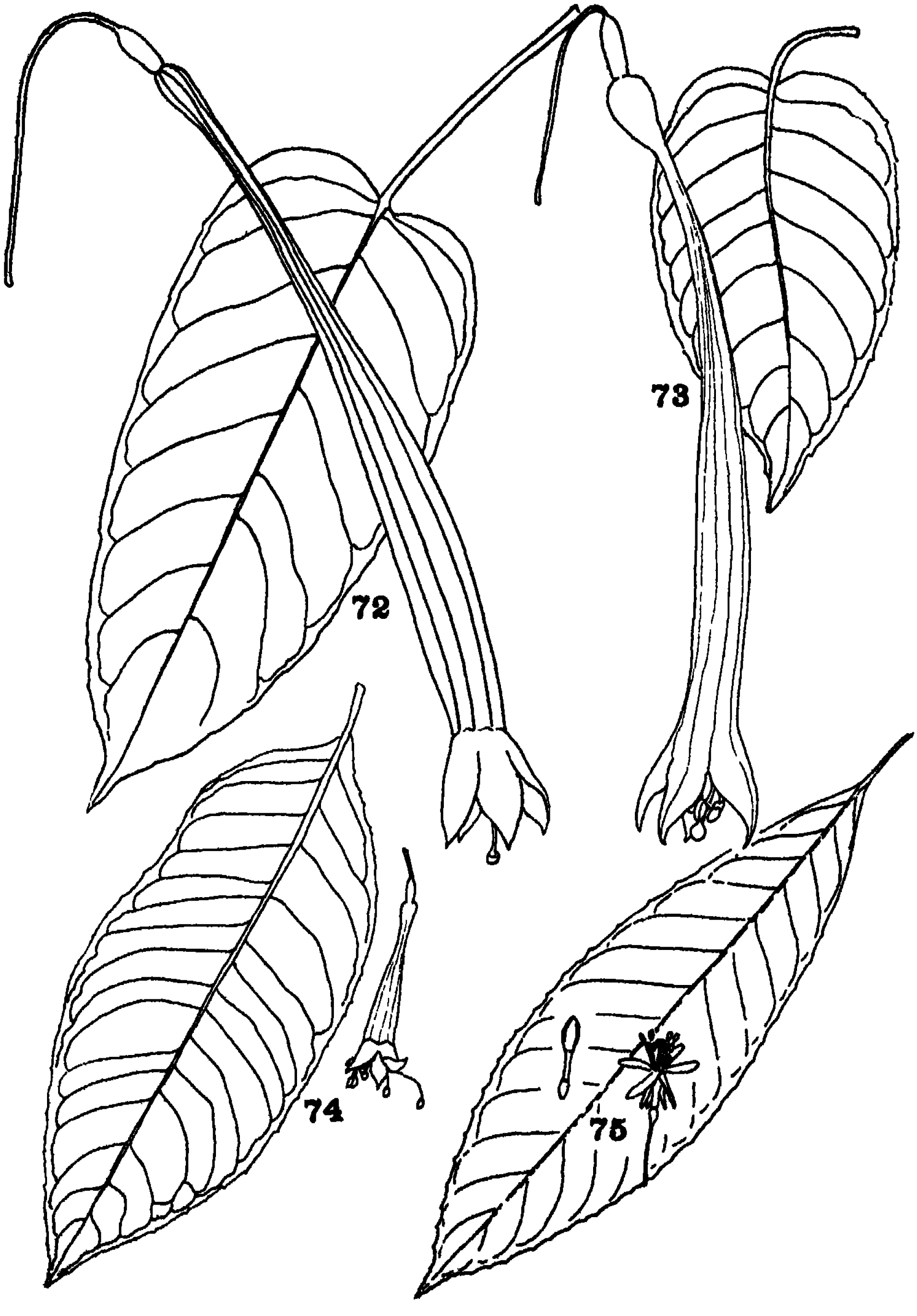

PLATE 15

Fig 76 F *thymifolia*, from Pringle 9794, flower 11 mm , leaf 21 mm

Fig 77 F *Pringlei*, from Pringle 4140, flower 7 mm , leaf 20 mm

Fig 78 F *colimae*, from Jones 224, flower 6 mm , leaf 20 mm.

Fig 79 F *minimiflora*, from Rose and Hay 5521, flower 5 mm., leaf 14 mm

Fig 80 F *tacanensis*, from Matuda 1686; flower 13 mm , leaf 80 mm

Fig 81 F *Skutchiana*, from Skutch 812, flower 7 mm , leaf 75 mm.

Fig 82 F *bacillaris*, from Hort Bot Petrop , 1829, flower 16 mm , leaf 30 mm

Fig 83 F *minutiflora* var *hidalgensis*, from Pringle 8807, flower 11 mm , leaf 14 mm

Fig 84 F *microphylla*, from Pringle 4314, perfect flower 18 mm , leaf 17 mm , pistillate flower 10 mm , from Hartweg 285

Fig 85 F *Hemsleyana*, from Davidson 876, flower 11 mm , leaf 15 mm

Fig 86 F *striolata*, from Matuda 4004, flower 7 mm , leaf 95 mm

Fig 87 F *michoacanensis*, from Standley 67188, perfect flower 11 mm , leaf 40 mm , pistillate flower from Standley 58934, 8 mm

Fig 88 F *Encliandra*, from Mexia 2718, staminate flower 18 mm , leaf 25 mm , pistillate flower from Nelson 1803, 12 mm long

Fig 89 F *cylindracea*, from Arsène 6523, flower 15 mm , leaf 65 mm

Fig 90 F *tetradactyla, from* Popenoe 689, staminate flower 13 *mm* , leaf 40 mm , pistillate flower from Skutch 810, 15 mm

Fig 91 F *Mexiae*, from Mexia 1465, flower 7 mm , leaf 75 mm

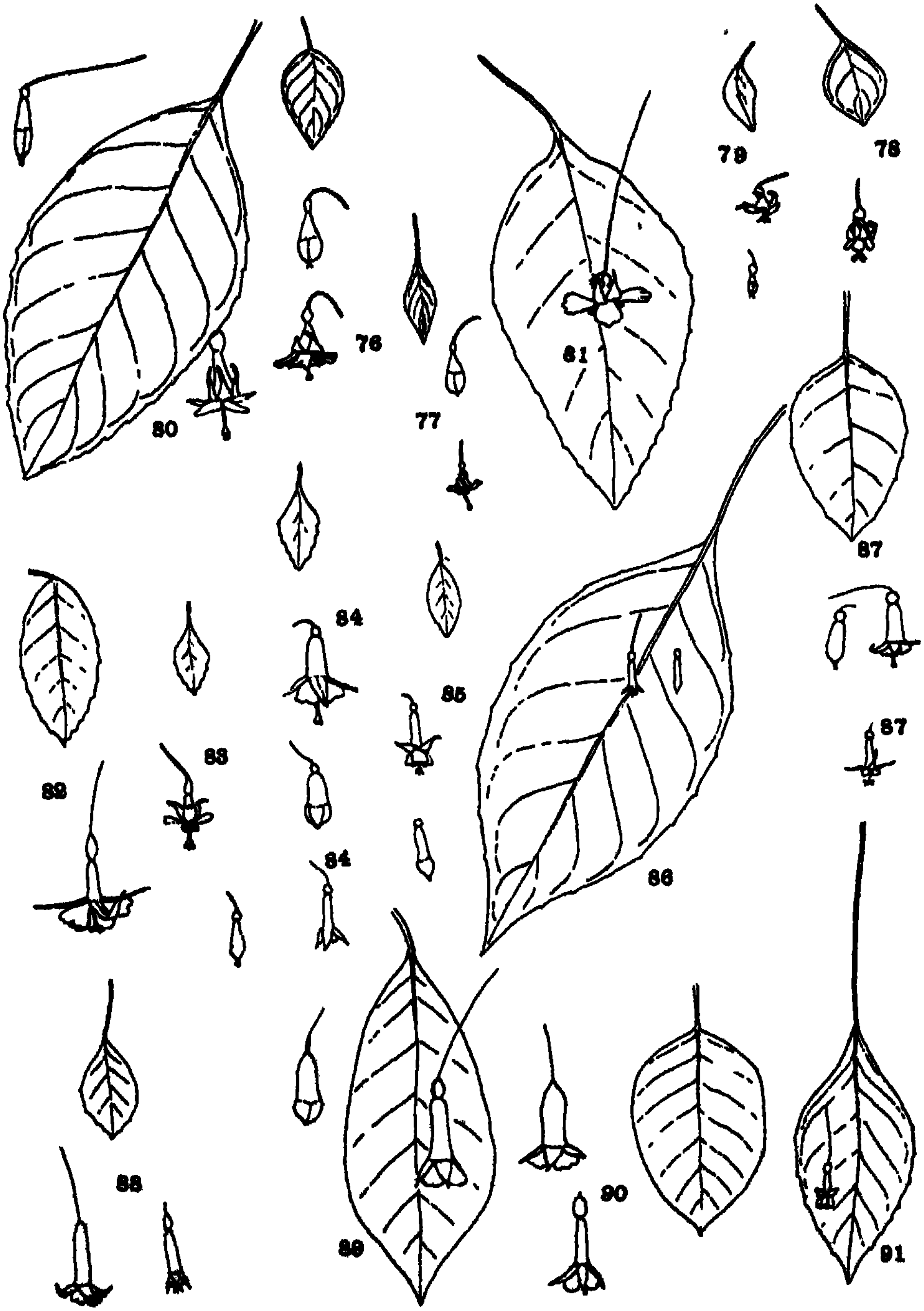
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PLATE 16

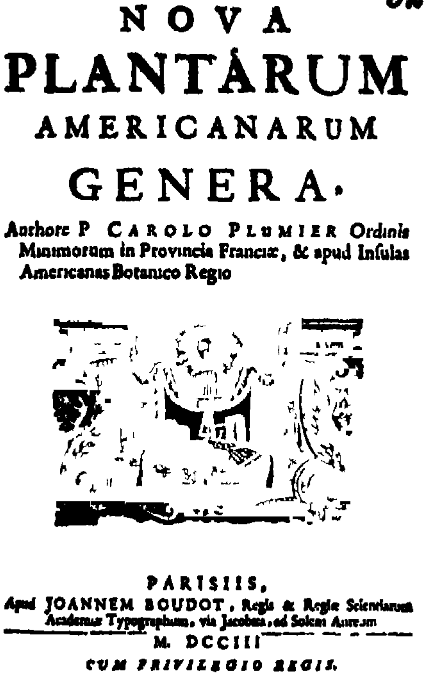
(Photographs by Dr. G Dallas Hanna)

Fig 92 Photograph of title page of Plumier's "Nova Plantarum americanarum Genera"

Fig 93 Photograph of Plate 14 of same with first illustrations of the Genus *Fuchsia*

Figs 94 and 95 Photographs of pages 14 and 15 of same containing the description of *Fuchsia* by Plumier

92

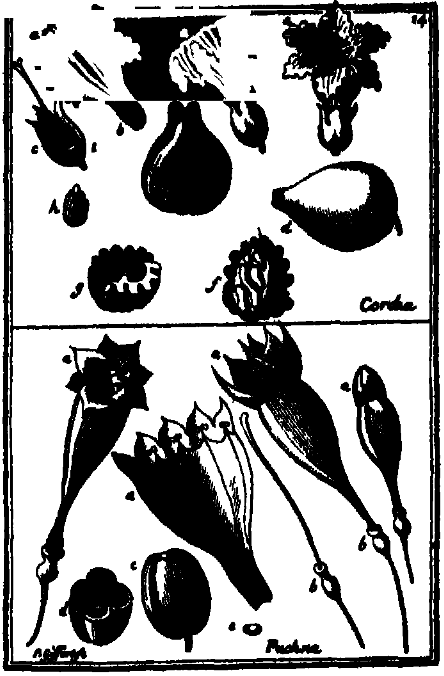


NOVA PLANTARUM AMERICANARUM GENERA.

Authore P. CAROLO PLUMIER Ordinis
Minimorum in Provincia Franciæ, & apud Insulas
Americanas Botanico Regio

PARISIIS,
Apud JOANNEM BOUDOT, Regis & Regiæ Scientiarum
Academiæ Typographum, via Jacobæa, ad Solem Aureum.
M. DCCIII.
CUM PRIVILEGIO REGIS.

93



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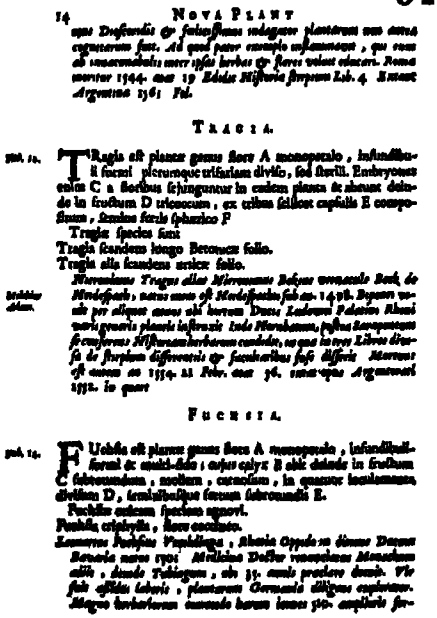


14 NOVA PLANT.

quos Dioscorides & felicissimus indagator plantarum non antea cognitarum fuit. Ad quod patet exemplo [illegible], qui cum ab incunabulis inter ipsas herbas & flores volunt educari. Romæ moritur 1544. ætat. 29. Edidit Historiam stirpium Lib. 4. Extant Argentinæ 1561. Fol.

TRAGIA.

Tab. 12. Tragia est plantæ genus flore A monopetalo, infundibuliformi plerumque trifariam diviso, sed sterili. Embryones autem C a floribus sejunguntur in eadem planta & abeunt deinde in fructum D tricoccum, ex tribus scilicet capsulis E compositum, semine foeto sphærico F.

Tragiæ species sunt
Tragia scandens longo Betonicæ folio.
Tragia alia scandens urticæ folio.

Hieronymus Tragus alias Hieronymus Bock vernacule Bock, de Hindelspach, natus enim est Heidelspachii sub an. 1498. Deponit vero per aliquot annos ubi hortum Ducis Ludovici Palatini Rheni [illegible] instruxit. Inde Hornbacum, [illegible] Historiam herbarum condidit, in qua in tres Libros divisa de stirpium differentiis & facultatibus fuse disserit. Mortuus est autem an. 1554. 21. Febr. ætat. 56. [illegible] Argentorati 1552. in quarto Melchior Adam.

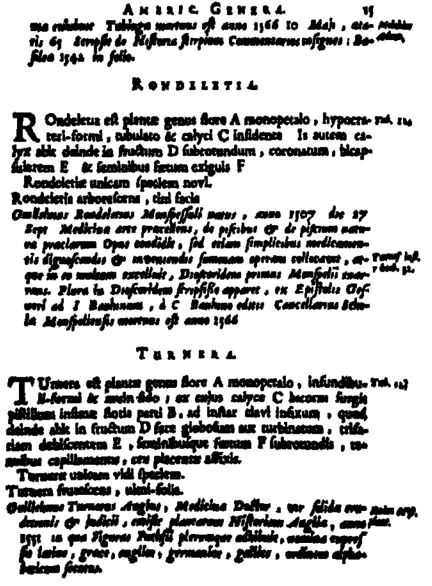
FUCHSIA.

Tab. 14. Fuchsia est plantæ genus flore A monopetalo, infundibuliformi & multifido; cujus calyx B abit deinde in fructum C subrotundum, mollem, carnosum, in quatuor loculamenta divisum D, seminibusque foetum subrotundis E.

Fuchsiæ unicam speciem agnovi.
Fuchsia triphylla, flore coccineo.

Leonartus Fuchsius Vuembdingæ, Bavariæ Oppido in ditione Ducum Bavariæ natus 1501. Medicinæ Doctor [illegible] aliis, deinde Tubingam, ubi 33. annis praeclare docuit. Vir fuit assidui laboris, plantarum Germaniæ diligens explorator. Magno herbariorum [illegible] horum icones 516. amplius fer-

95



AMERIC. GENERA. 15

mis cœlavit. Tubingæ mortuus est anno 1566. 10. Maji, ætatis 65. Scripsit de Historia stirpium Commentarios insignes: Basileæ 1542. in folio. Melchior Adam.

RONDELETIA.

Rondeletia est plantæ genus flore A monopetalo, hypocrateriformi, tubulato & calyci C insidente. Is autem calyx abit deinde in fructum D subrotundum, coronatum, bicapsularem E & seminibus foetum exiguis F. Tab. 14.

Rondeletiæ unicam speciem novi.
Rondeletia arborescens, tini facie.

Gulielmus Rondeletius Monspeliensis natus, anno 1507. die 27. Sept. Medicinæ arte præcellens, de piscibus & de piscium natura præclarum Opus condidit, sed etiam simplicibus medicamentis dignoscendis & inveniendis summam operam collocavit, atque in eo maxime excelluit, Dioscoridem primus Monspelii enarrans. Plura in Dioscoridem scripsisse apparet, ex Epistolis Gesneri ad J. Bauhinum, à C. Bauhino editis. Cancellarius Scholæ Monspeliensis mortuus est anno 1566. Tournef. Isag. [illegible]

TURNERA.

Turnera est plantæ genus flore A monopetalo, infundibuliformi & multifido; ex cujus calyce C lacerum surgit pistillum infimæ floris parti B, ad instar clavi infixum, quod deinde abit in fructum D fere globosum aut turbinatum, trifariam dehiscentem E, seminibusque foetum F subrotundis, quibus capillamenta, vel placenta affixa. Tab. 12.

Turneræ unicam vidi speciem.
Turnera frutescens, ulmi-folio.

Gulielmus Turnerus Anglus, Medicinæ Doctor, vir solidæ eruditionis & judicii, scripsit plantarum Historiam Anglice, anno 1551. in qua Figuras Fuchsii plerumque adhibuit, nomina expressit latine, græce, anglice, germanice, gallice, ordinem alphabeticum secutus. [illegible]

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CALIFORNIA ACADEMY OF SCIENCES
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ALICE EASTWOOD
SEMI-CENTENNIAL PUBLICATIONS

No. 2

RELATIONS OF THE TEMPERATE FLORAS OF NORTH AND SOUTH AMERICA

BY

DOUGLAS HOUGHTON CAMPBELL
Professor of Botany, Emeritus
Stanford University

THE DISTRIBUTION of the existing land floras of the world, as well as their fossil record, have been studied by many botanists for a long time These botanists have been, for the most part, Europeans or Americans, and have especially studied the floras of the Northern Hemisphere, and the history of the Holarctic vegetation is fairly well known There is much less information concerning the history of the floras of the Southern Hemisphere, especially the fossils Since we now have as allies most of the South American countries, it might be well for us to become better acquainted with the botanists of South America and their studies of the floras of those countries

Great changes have occurred during past ages in the distribution of land and water of the globe, and great mountain ranges now stand where once the sea covered the land These changes in the distribution of the main bodies of land and water have undoubtedly had much to do with fluctuations of climate and the distribution of many plants

Thus the invasion of the sea in the Cretaceous Age over much of the western United States, and later, the elevation of the Rocky Mountains and the Sierra Nevada and Cascades, had a very marked effect on the climate of those regions and the distribution of the vegetation During the Mid-Tertiary, for example, the redwood (Sequoia) now practically restricted to California, occurred over much of North America and Eurasia, and the southern cypress (Taxodium) now confined to the southeastern States was equally widespread

The great Pleistocene glaciation caused a great redistribution of the floras of North America and Eurasia, and many American trees, like the tulip tree (*Liriodendron*), magnolia and walnut, before the Ice Age lived also in Europe but were completely exterminated there at that time

EXISTING FACTORS IN DISTRIBUTION

Among the factors of prime importance in the distribution of the existing floras, the first is, perhaps, the relations of the great continental masses to each other, and to the surrounding oceans The latter are effective barriers to the migration of all but a very few plants, and high mountains and extensive areas of desert and arid regions such as occur in the center of the continents, also are barriers to migration, but mountains may also serve as highways—as may be seen in the occurrence of arctic and sub-arctic species in the Sierra Nevada and Rocky Mountains, far south of their normal habitat, and many plants are common to Chile and California.

The major part of the land surface of the globe is in the Northern Hemisphere and comprises North America and Eurasia It is generally recognized that these two continents have for a very long time been more or less intimately connected This is indicated by the evident close relationship of their floras, especially in the higher latitudes Throughout the Arctic and Subarctic Zones most of the trees, shrubs and herbaceous species are closely related, or even identical It has even been proposed to consider North America and Eurasia as parts of an ancient primary continent, "Laurasia"

The southern continents, South America, Africa, Australia and Antarctica, are separated from each other by the width of the great oceans Except for Antarctica which is destitute of terrestrial vegetation, the southern continents have varied and peculiar floras, indicating a long period of isolation Nevertheless they all have many obviously related genera, and even species, pointing to some ancient land connections

It has been held by some geologists that in the late Palaeozoic there existed a great southern continent, "Gondwana," which included all the existing southern continents, and also India Gondwana was separated from the northern land-masses by a broad oceanic belt, the "Tethys Sea" which persisted to near the end of the Mesozoic This perhaps explains the radical differences between the present temperate floras of North and South America

How the existing southern continents became so completely isolated has caused much speculation In a recent study of the subject by a South African geologist,[1] the author concludes that Gondwana split into segments which drifted apart and developed into the present continents This theory of Continental Drift, put forward by Wegener in 1912, is a plausible explanation of many puzzling facts in geographical distribution, both of animals and plants

The greater part of North America and Eurasia lies north of the Tropic of Cancer, and extends beyond the Arctic Circle Almost the whole of the United States lies in the "Temperate" Zone, between 30° and 50° N. For the most part the climate is distinctly "continental," with great annual range of temperature In general, winter is a season of complete cessation of plant activity In the United States milder climates prevail in the Southern States and especially on the Pacific Coast, where weather conditions are very different from those over most of the country From Sitka to San Diego, the climate is remarkably equable The January isotherm of 0°C, which on the Atlantic Coast is in the region of New York and Philadelphia, on the Pacific Coast is pushed north to Sitka (lat 57° N) In San Francisco, there is only a difference of ten degrees Fahrenheit between the coldest and warmest months (50° to 60°) , in Washington, D C , about the same latitude (32° to 78°)

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[1] Our Wandering Continents A L Du Toit London, 1937

The lofty barrier of the great Cordillera protects the coastal areas from the great temperature fluctuations of the interior regions, and the prevailing westerly winds from the Pacific have a great influence on both temperature and precipitation

In the strictly arctic regions, *e g* , Greenland, northern Canada and Alaska, trees are absent and the vegetation is made up for the most part of perennials, either herbaceous species with subterranean roots or root-stocks which during the brief growing season of perhaps two months, complete their season's growth, or a few woody species, *e g* , dwarf willows and birches, dwarf rhododendrons, cranberries and a few other bog-plants may be found In specially favorable places Iceland poppies, buttercups, saxifrage, with showy flowers, as well as some grasses, quickly develop from their perennial roots during the very brief summer months

Further south in the Sub-arctic Zone, trees begin to play an important role Thus in Canada, Scandinavia, Russia, there are extensive forests of spruce and pine, birches, willows and poplars and various deciduous shrubs, much the same throughout, from Alaska to Russia

The Sub-arctic merges gradually into the North Temperate which occupies much of North America and Eurasia In the United States, especially in the eastern portion, this zone is characterized by an extraordinary variety of deciduous trees—oaks, beech, ash, elm, walnut, hickory, chestnut, and many others, which occur over most of the region east of the Mississippi

About two-thirds of the United States lie between the Rocky Mountains and the Atlantic Ocean This includes the great Mississippi Valley and the Great Lakes The vast area between the Rocky Mountains and the Appalachians has no barriers to plant migration except climatic ones, *e g* , temperature and rain-fall, and many species are distributed over most of the area Thus several species of oak, the black walnut and American elm occur over most of the area eastward of the Rocky Mountains, except where the moisture is insufficient

The rainfall decreases westward and the forest gives way to the prairies West of the Mississippi trees usually occur only along streams The prairies finally pass into the semi-arid steppes which occur at the base of the Rocky Mountains. These plains are characterized by scattered bunch grasses and low shrubs, together with some herbaceous species

The western third of North America is very different from the East It is a region of mountains and elevated plateaus between the Rocky Mountains and the Pacific Coast This region includes extensive plateaus and secondary mountain ranges Much of the plateau region is arid and in some places, as in the Salt Lake region, and parts of Nevada, true deserts

The great Pacific Cordillera which, with few breaks, extends from Alaska to Patagonia, sharply sets off the Coastal Region from the rest of the Continent The whole of the western Mountain area is very different climatically and floristically from Atlantic North America, and is the only portion of the United States in which the highest mountains have perpetual snow and a true alpine flora

Southern California and western Mexico have very light rainfall and much of the country is desert, but the precipitation increases rapidly northward, and in northwestern California the rainfall is very heavy, and from central California northward through Oregon, and Washington to Alaska, there is heavy rainfall, resulting in the development of the greatest coniferous forest in the world

In the Gulf region, especially Florida, there are many types, like the palms, *Ficus* and Bromeliads, evidently derived from the tropical regions to the south

Central California is a meeting ground for the boreal floras of North America and the subtropical floras of Mexico There is also a considerable number of genera and even species common to California and central Chile

The coastal ranges of central California, with their cool, moist forests, contain many distinctly boreal types, like most of the conifers, as well as such deciduous trees as maples, oaks and alders, and deciduous shrubs, honeysuckle, roses, elder, spiraea, azalea, rhododendron, dogwood, and others, and many characteristic herbaceous flowers, e g , *Trillium, Erythronium, Ranunculus, Oxalis,* saxifrage, *Aquilegia,* violets, and many others.

With decreasing precipitation southward, these northern types are gradually replaced by genera and species absent from the eastern States or only occasionally found, e g , *Acacia,* cacti, *Yucca, Prosopis, Mimulus, Penstemon, Castilleja,* and others

The occurrence in California of a considerable number of species found also in Chile is remarkable. Among these may be noted *Fragaria chilensis, Prosopis juliflora, Mesembryanthemum aequilaterale, Calandrinia Menziesii*

The temperate regions of South America include a small part of southern Brazil, Paraguay, Uruguay, Argentina, and Chile, the two latter comprise the greater part of temperate South America. Between Chile and Argentina is the great barrier of the Andes, a condition similar to that separating the coastal region of California from Nevada and Arizona, and there is much the same difference between the coastal and inland climates in both cases, as well as in the vegetation

The central and southern parts of Chile have abundant rainfall, while in most of Argentina the precipitation is scanty, and much of the country is a desert The continent diminishes in breadth southward, its southernmost point, Cape Horn, being less than 60°S

Owing to the proximity of the oceans, the climate is insular rather than continental, and there is nothing comparable to the Arctic Zone of the northern continents Similar conditions prevail in temperate South Africa and Australia, where the southernmost regions are under 50°S Excepting in the high mountains there is no such difference between winter and summer as exists in corresponding latitudes in the Northern Hemisphere Thus in Ushuaia, in Tierra del Fuego (lat 55 5°S) the coldest monthly average is 28 9°F, the warmest 50°, at Nain (Labrador) in about the same latitude North, the range is -7°F to 46°, in Buenos Aires (lat 35 5°S) the coldest month is 50°F, the hottest, 73 6° St Louis, about the same latitude North, has the range of 31° to 79 1°

As a whole the temperate floras east of the Andes are very poor compared with corresponding areas in North America While the flora of Argentina is mainly related to the Brazilian regions to the north, there are also elements related to those of Chile, especially in the extreme south, where there is abundant rainfall, and where the so-called "Subantarctic" flora becomes evident This flora is also related to that of New Zealand and South Australia

The transition from southern Brazil to Argentina is a gradual one with increasing aridity southward The strip at the base of the Andes is very dry, with scanty vegetation, and might be compared to the most extreme deserts of Arizona and Nevada It has been described as one of the most dismal and sterile regions that one could imagine The precipitation increases somewhat toward the east, and much of central Argentina is occupied by the great pampas, recalling the great plains of the central United States, and like the prairies there is a great development of grasses and other herbaceous plants The constituents of the pampas floras are for the most part quite different species from those in North America. In general the flora of northern Argentina is evidently related to that of southern Brazil

Southward the pampas merge into the arid, sterile plains of Patagonia, where only such scanty vegetation is found as can survive the stony, exposed, and excessively dry conditions which prevail

The conditions in Chile, west of the Andes, are very different from those in Argentina The coast of Chile extends from 16° 57′ S to 55 S (the southernmost point in South America—Cape Horn) This corresponds to the north Pacific Coast from Lower California to Alaska.

The northern coast of Chile is practically rainless, and much of the region is quite destitute of vegetation. Passing southward, the precipitation gradually increases, and in the central region, *e g*, Valparaiso, Santiago, conditions are very similar to those in Central California, and the general character of the vegetation, both native and cultivated, is very much the same

Trees and shrubs from California, *e g*, *Sequoia*, Monterey Cypress, *Ceano-*

Patagonia, Tierra del Fuego, and Chile, representing the "Subantarctic" regions This indicates that the Tertiary climate in Patagonia was both warmer and more humid than at present There were no North American genera present, but the most remarkable case was Ginkgo, unknown elsewhere in South America

A recent study of fossil conifers from Chile (The Tertiary Fossil Conifers of South Chile and their Phytogeographical Significance) by Rudolph Florin, Stockholm, 1940, shows that the genera were the same as now exist, and that none of the characteristic North American genera, *e g* , *Pinus, Abies, Tsuga, Picea,* were present Florin states that the same complete separation of the northern and southern types has existed since the late Palaeozoic

From a study of the existing floras as well as the fossil forms, one may conclude that the floras of South America have developed independently, except for the so-called "Subantarctic" floras, which probably originated in some common land-mass, perhaps the hypothetical Gondwana This seems much more likely than that they originated in some northern extension of the present Antarctica

Acceptance of the recent hypothesis of Du Toit, that there were two primordial continents, Laurasia in the Northern Hemisphere and Gondwana in the South, and from these primary continents, the existing continents were separated and shifted to their present positions, would, if true, remove most of the difficulties in explaining the present distribution of many existing plant families

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ALICE EASTWOOD SEMI-CENTENNIAL PUBLICATIONS

No. 3

PUGILLUS ASTRAGALORUM ALTER

BY

R C BARNEBY

The observations on *Astragalus* contained in the present paper† are based primarily on material gathered by Mr H D Ripley and the writer in California, Nevada, Utah, and Arizona during the past two or three years Through the kindness of Dr P A Munz it has been possible to make critical comparisons with a number of types in the herbarium of Marcus E Jones at Pomona College (PO), without which these notes could not have been prepared In addition, the writer has had an opportunity to visit several herbaria in the East, and there to study type and other specimens not represented in California collections To the gentlemen in charge of these herbaria, in particular to Prof M L Fernald of the Gray Herbarium at Harvard University (G), Dr. H A Gleason of the New York Botanical Garden (NY) and Dr P C Standley at the Field Museum (F), who generously placed at my disposal the collections in their care, I wish to express my lively appreciation I am also especially grateful to Miss Alice Eastwood for the communication of the type specimen of *Astragalus Bryantii*, described below The capital letters in parentheses have been used throughout the paper to denote the herbarium in which cited material has been seen

Types of all species and varieties described as new are deposited in the herbarium of the California Academy of Sciences together with duplicates of the collections discussed

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† Mr Barneby's earlier paper on *Astragalus*, "Pugillus Astragalorum Nevadensium," was published in Leaflets of Western Botany 3 97-114, figs A-F 1942

Astragalus diversifolius A Gray

Astragalus diversifolius A Gray, Proc Amer Acad 6 230 1864 *Homalobus orthocarpus* Nutt ex T and G, Fl N Amer 1 351 1838 *A convallarius* Greene var *diversifolius* (A Gray) Tidestr, Proc Biol Soc. Wash 50 20 1937

Utah clay slopes among junipers, 3 miles south of Enterprise, Washington Co, alt 6300 ft *Ripley and Barneby 4967*

This station extends the range of the species as known to the writer almost to the borders of Arizona, to which state it is accredited by Tidestrom (Fl Ariz and N Mex 197 1941), though not admitted by Kearney and Peebles, who record only *A junciformis* A Nels of this immediate group as native to the state Prof Tidestrom's plant is unknown to me, but his combination is in any case untenable If the plants originally named by Nuttall as *Homalobus orthocarpus* and *H campestris* cannot be separated specifically, the oldest valid binomial for either element of the complex must be given the rank of species, not reduced to varietal status under a subsequently published name *A diversifolius* A Gray, founded on *H orthocarpus*, appeared 29 years earlier than *A convallarius* Greene (1893), which was proposed to replace *A campestris* (Nutt) A Gray (1864) non Linné (1753) Even if the combination *A diversifolius*, often wrongly applied, were discarded as a *nomen confusum*, *A ibapensis* M E Jones, in all probability an exact synonym of *H orthocarpus* and published in January of 1893, will take precedence over *A convallarius* published in October of the same year But the taxonomy and involved nomenclature of this group are still in need of critical revision

Astragalus Whitedii Piper fma **speirocarpoides** Barneby, forma nova

(Plate 17, fig 31)

Astragalus Whitedii Piper fma *speirocarpoides* Barneby fma nov a prole typica (seu *A speirocarpo* var *falciformi* A Gray) legumine in annulum saltem completum vel saepius sesquialterum contorto, nec falcato tantum, diversa

Nevada in deep sandy soil among sagebrush, **10 miles north of Winnemucca, Humboldt Co**, alt 4500 ft, 23 May, fl and fr *Ripley and Barneby 4552* *Type* in Herb Calif Acad Sci No 300414 Also at Austin, Lander Co, *Jones*, 16 June 1882 (PO, annotated as *A Gibbsii* var)

With its fruit twisted into one or one and a half spiral coils, the proposed forma is very similar in aspect to the true *A speirocarpus* A Gray of Washington and northern Oregon, but the long calyx (tube 8 mm), rather coarse, procumbent stems and broad leaflets are all characteristic of *A Whitedii*, in the typical form of which the pods are not more than strongly falcate It should be noticed that the fma *speirocarpoides* invalidates Rydberg's key to *Homalobus* Ser *Collini* (N Amer Fl 24 258 1929), from which this plant would appear to belong to *A speirocarpus*

Astragalus zionis M E Jones

Astragalus zionis M E Jones *Xylophacos zionis* (Jones) Rydb

ARIZONA sandy declivities under the Echo Cliffs near Limestone Tanks, about 13 miles south of Navajo Bridge, alt 5200 ft, 7 June, fr *Ripley and Barneby 4868* Also observed, but not collected, under the same cliffs 11 miles north of Cedar Ridge.

An addition to the flora of Arizona The specimens are slightly abnormal in having the peduncles much shorter than is usual in material from Zion and the Virgin Valley, while the whole plant is more copiously pubescent

Astragalus panguicensis M E Jones

Astragalus panguicensis (M E Jones), M E JONES, Contrib W Bot 10 62, tab 4 1902 *A Chamaeleuce* var *panguicensis* M E JONES, Proc Calif Acad Sci (II), 5 671 1895 *A argophyllus* var *panguicensis* M E JONES, Contrib W Bot 8 5 1898, Rev Astrag 207, tab 47 1923 *Xylophacos vespertinus* RYDB, N Amer Fl 24 299 1929, pro parte, quoad syn cit, non *A vespertinus* Sheld

UTAH gravelly benches in yellow pine forest west of Alton, Kane Co, alt 6800 ft, 5 June, fl and fr *Ripley and Barneby 4822*

It is not without some misgiving that the collection is referred to this obscure species, for the type, *Jones 6023 f*, and only specimen of *A Chamaeleuce* var *panguicensis* at Pomona is a very mature and imperfect plant without either flower or fruit In an envelope attached to the sheet there is a single pod marked in Jones' hand "probably the type of *A panguicensis*," but this creates a further difficulty, for the pod does not agree as closely with the figures or description published by Jones as do the fruits of our specimens, and it may never have belonged there The plant itself differs from ours in being evidently caulescent and in having, for the most part, broader and more obtuse leaflets Many species of this group, however, even if quite stemless at first, tend to become caulescent late in the season, and we have one specimen which in shape of leaflets closely matches the type In both collections the stipules and the characteristically dense, silvery, subappressed pubescence are identical, and it should be remembered that the type locality, Panguitch Lake, is in the same massif as our station and not more than twenty miles distant Certainly our plant can be referred to no other described species

If our determination is accepted as correct it becomes evident that *A panguicensis* has been universally misunderstood Jones first described it as a variety of *A Chamaeleuce* A Gray, three years later transferred his variety to *A argophyllus* Nutt, then raised it to specific rank, and finally, in the Revision of Astragalus, returned it as a variety to *A argophyllus* Rydberg, evidently without first-hand knowledge of the plant, reduced it to the very different *A vespertinus* Sheld Actually the small, pale purple or ochroleucous flowers and the quality of the pubescence suggest an affinity with *A. castaneiformis* S. Wats, from which it is immediately distinguished by the curved, lanceolate and much longer pod

Astragalus uncialis Barneby

Nevada Currant (Callaway), Nye Co , 12 May, flor. *Ripley and Barneby 4481*, topo type Also 20 miles to the west, in the foothills of the Pancake Range near Lockes. *No 4483*

A uncialis was described from fruiting material and the fresh flower was unknown As surmised by the writer, the corolla is of a brilliant purple, similar to that found in *A utahensis* (Torr) T & G though perhaps of a somewhat more violet tinge

Astragalus marianus (Rydb) Barneby comb nov

Xylophacos marianus Rydb., Bull Torr Cl 52 233 1925, N Amer Fl 24 301 1929 *A Purshii × Newberryi* M E Jones, Rev Astrag 216 1923

Nevada frequent on dry benches under pines and aspens along Snake Creek, near Treasure Lake, Snake Range, White Pine Co , alt ca 8200 ft , July, fr *Ripley and Barneby 4036*

This rather well-marked species has been reported only from the mountains of southern and central Utah, where it is of not uncommon occurrence in sagebrush valleys between six and eight thousand feet The plants from Nevada are not identical with the type, but have the broader leaflets of *Fremont 406* (NY) from Utah Lake referred to *X marianus* by Rydberg (*l c*, 1925), and without doubt represent a shade form of the species Another gathering from the state, our no *3515* from talus slopes beneath limestone cliffs in the canyon of the Muddy River near Caliente, Lincoln County, at 4500 feet may also belong here, but the determination is not certain The specimens resemble *A marianus* closely in habit, in the slender, often well-developed caudices and numerous, small, appressed-sericeous leaflets, but in the dense floccose pubescence of the pods they recall *A Newberryi* A Gray or even *A Blyae* (Rose) Tidestr The locality is well below the normal altitudinal limit of *A marianus* and it may be that the plants had seeded down from a higher level of the Highland Range into a soil where lack of humidity and greater temperature might account for the increased density of vesture Further investigation, particularly of the flowers, may reveal an undescribed species

Astragalus sabinarum (Rydb) Barneby comb nov

Batidophaca sabinarum Rydb , N Amer Fl 24 320 1929.

Only the type specimen from Iron County, Utah (*Garrett R2660*, NY), has been seen by the writer, but this clearly represents a good species The combination in *Astragalus* is proposed in order to facilitate comparison with its nearest ally, *A musimonum* nob , described below

Astragalus musimonum Barneby sp nov

(Plate, 17, figs 1–9)

Astragalus musimonum Barneby sp nov ex affinitate *A sabinarum* (Rydb.) nob a quo pendunculis validis elongatis folia multo superantibus, racemis plurifloris, dentibus calycinis abbreviatis haud nigro ciliatis, et praesertim legumine parcius strigoso ad

apicem abrupte hamato recurvo facillime diagnoscenda Habitu *A amphioxys* A. Gray affinesque nonnullas species aliquantulum refert, sed calyce campanulato carinaque lata ab Argophyllis (sive *Xylophacos* Rydb) omnibus graviter discrepat

Herba perennis depressa caespitosa breviter caulescens, pilis argenteis adscendentibus basifixis imprimis arcte appressis paucisque patulis commixtis undique strigoso cana caulibus compluribus prostratis saepe flexuosis incanis e collo radicis lignosae verticalis emissis, 2–7 cm longis, fere ex ipsa basi racemigeris stipulis primum imbricatis demum in ternodio 3–9 mm longo separatis, lanceolatis vel ovato lanceolatis acutis, 3–5 mm longis, praeter nervum medianum viridem omnino hyalinis vel superne herbaceis, mox scariosis, inferne glabratis intus glabris longe ciliatis ad basin petiolo breviter adnatis *foliis* humi appressis 4–10 cm longis, petiolo gracili elongato leviter canaliculato rachin saepissime superanti *foliolis* 5–9 jugis parvis remotiusculis inferioribus plerumque alternis articulatis obovatis ellipticis oblanceolatisve, apice rotundatis acutis vel apiculatis 3–7 mm longis, 2–3 *mm latis, secus rachin sursum decrescentibus* pedunculis *numerosis, praecocioribus* subradicalibus, prostratis validis striatis parcius strigosis viridulis, iam ad anthesin folia superantibus fructiferis elongatis racemis brevibus 7–12 floris primum subcapitatis ca 1 5 cm longis, mox laxioribus, demum 4–6 cm longis bracteis ovato acuminatis ca 3 mm longis hyalinis ciliatis pedicellis firmulis, vix 1 mm longis, adscendentibus calycis purpureo tincti extus strigoso cani tubo campanulato postice valde gibbo 3 5 mm longo, 2 mm lato, legumine accrescenti nunquam rupto, dentibus subulatis acutis 1 5 mm longis petalis laete violaceo purpureis, vexillo macula magna elliptica alba superne pulchre pluristriata instructo vexillo 12–14 mm longo, supra unguiculum brevem et angustum in limbum plicatum late oblongum 4 mm latum obtusum apice emarginatum abrupte expanso, infra medium plus minusve retro arcuato, marginibus reflexis alis ca 10 mm longis, carinam paullulum superantibus, lamina anguste lanceolato lunata ca 1 5 mm lata, auriculo parvo reflexo incluso 7 mm longa petalorum carinalium lamina oblique ovato lunata 6 mm longa, saltem 2 5 mm lata, marginibus superioribus leviter concavis, inferioribus connatis supra medium in apicem porrectum plerumque obtusissimum per angulum fere rectum sursum *arcuatis* legumine patulo *sessili* uniloculari, ambitu anguste elliptico, *falcato*, 1 5–2 0 cm longo, utrinque angustato atque compresso, medium versus admodum obcomresso vel saltem dorsaliter sulcato, in *rostrum* abrupte *hamato recurvum stylo persistenti cuspidatum sursum* attenuato, sutura ventrali per longitudinem totam acuta sensim concava, dorsali inferne subrecta, ad medium prominula sed ob leguminis obcompressionem ibi depressa, ad rostrum acutissima abrupte convexa, sectione transversali anguste obcordata 5–6 mm lata, ca 2 mm alta, valvulis coriaceis sparsiuscule albostrigosis transverse striatis immaculatis seminibus maturis ignotis

NEVADA calcareous gravel slopes of the **Sheep Mts**, **near the entrance to Deadman Canyon, Clark Co.**, alt 5700 ft , 5 May, fl & fr *Ripley and Barneby 3352 Type* in Herb Calif Acad Sci No 300411

A. musimonum, with its cespitose, very shortly caulescent, prostrate stems, silvery-strigose herbage and racemes of purple flowers, has at first sight the aspect of a slender form of *A amphioxys* A Gray, but the companulate calyx-tube, broad keel and thin-walled pod indicate a relationship with that group of *Astragali* segregated by Rydberg as the genus *Batidophaca,* and among those species it finds a natural place beside *A sabinarum* in the series *Villosae* (cf Rydb , *l c*) From the latter it differs in the short calyx-lobes, more numerous flowers and more copious pubescence of straight, appressed hairs, while the mature fruits, laxly racemose on the stout, elongate and at length reclining peduncles, are comparatively glabrate, attenuate at base and

abruptly hooked at apex, in contrast with the canescent, regularly lunate pod of *A sabinarum*

A musimonum has been known in the type locality on the western slope of the Sheep Mountains for several years, but adequate fruiting material has only recently been obtained In this station it is local but abundant on calcareous benches in the Upper Sonoran Life-zone and seems to belong to the calciphile foothill flora of which, in southern Nevada, *Actinea Cooperi* (A Gray), O Kze, *Senecio stygius* Greene and *Astragalus Tidestromii* (Rydb) Clokey are characteristic elements Immature specimens from northern Arizona, found growing under similar conditions at 5300 feet in Mokiak Pass, Mohave County (No *4321*), are almost certainly to be referred to *A musimonum*, but in absence of the legume the determination remains in doubt

The proposed trivial, from the Latin '*musimon*,' alludes to that magnificent race of the Mountain Sheep, now happily preserved from extinction, which is native to the Sheep Mountains, and from which the name of the range itself is certainly derived

Astragalus pinonis M E Jones

Pisophaca pinonis (M E Jones) Rydb

NEVADA Highland Range west of Caliente, Lincoln Co , alt 5200 ft , 20 May, fl & fr *Ripley and Barneby 3487a* Currant Creek, N E Nye Co , alt 6200 ft *No 3640*

This rare species has been known hitherto only from Beaver (Frisco, *Jones*, the type collection) and eastern Juab (Tintic, *Jones*) Counties, Utah Our specimens are taller and better developed than Jones' evidently depauperate type, with pods up to 2 5 cm in length, but they are essentially alike in structure and pubescence The plants were found only as isolated individuals and appeared very scarce

Astragalus oophorus S Wats

NEVADA Head of Lee Canyon, Charleston Mts , Clark Co , alt 9100 ft , *Ripley and Barneby 4979*

Through the kindness of Mr Ira W Clokey it has been possible to compare this collection with *Train 2141* from the same locality which was cited in a recent paper on the Astragali of the Charlestons (Clokey, Madroño 6 . 217 1942) as *A artipes* A Gray Study of the more ample material now available makes it clear that the Charleston plant is more justly referred to *A oophorus*, but the original determination, which was made by the Bureau of Plant Industry and based on meager and somewhat atypical specimens, is readily understandable when it is realized how variable and how closely allied the species are, and how incorrectly they have been interpreted in the past

In fact there seems to be little ground on which *A oophorus* and *A artipes* can be separated specifically, for, while the typical phases occupy distinct, contiguous areas, there occur, particularly toward the southern limit of *A oophorus*, specimens which are to some degree intermediate *A artipes* of northern Arizona, middle Utah and adjacent Colorado is distinguished by the cream-colored flowers and by the oblique legume with nearly straight ventral and strongly convex dorsal sutures *A oophorus,* on the other hand, a common species throughout central Nevada which extends into transmontane California along Owens Valley to the Panamints, has flowers with purple banner and keel, and a regularly ellipsoid pod with either suture about equally convex In southern Nevada and in the Panamints, however, purple-flowered plants are sometimes found with somewhat oblique legumes, in which case the only absolutely reliable criterion is the color of the flowers This raises a serious difficulty, since Watson, in the original publication, described the flowers of *A oophorus* as ochroleucous This I believe to have been an error. Not only is the pigment in the petals of *A oophorus* extremely fugacious in the herbarium, but among the numerous collections of the species made in Nevada in recent times not one with ochroleucous flowers has been detected I have myself collected the species to the north, south and east of the type-locality (at Austin, in the Toyabe Range and in Montgomery Pass), yet among thousands of individuals none was observed without purple keel and banner Apart from the value of the flower color as a taxonomic criterion,* the matter is of special importance in so far as it has affected the interpretation of *A oophorus* by Jones and Rydberg Evidently it was a factor in Jones' treatment of *A artipes* from middle Utah as *A oophorus* (and simultaneously of the purple-flowered *A oophorus* as *A artipes*), while it also prompted Rydberg to recognize in *A oophorus* two species of *Phaca, P oophora* and *P jucunda,* separated mainly by this very character

For many years Jones seems to have considered these two names synonymous, and in the Index to the Revision of Astragalus he actually stated that "*A artipes* is *oophorus*" Nevertheless his real intentions at this time seem to have been otherwise, for on Plate 22 of the same work appears a figure under the name "var *artipes*" and the combination is repeated in the Index to Plates By a curious misprint, however, it was not validly published On page 121 of the Revision, immediately following a detailed description of *A oophorus* (in which the pod described is clearly that of *A artipes*) are printed two short paragraphs, both under the heading *A oophorus* var *caulescens* There seems to be no doubt that the first line of the upper paragraph should have read "*A oophorus* var *artipes* (Gray, Proc Amer. Acad 13 370" which would join on comprehensively with "(1878) as species)" of the second line But Jones' confusion went deeper than a mere typographical lapsus, for the plant figured as var *artipes* is plainly nothing more than *A oophorus* in the strictest sense, while the true *A artipes* of Gray is represented by the *A oophorus* var *caulescens* of the second paragraph and of the

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*** An exact parallel is found in the case of *A Beckwithii* T and G and its vicariant var *purpureus* M E Jones (*A artemisiarum* M E Jones) The former, with ochroleucous flowers, so common in western Utah, passes westward, almost exactly at the Nevada line, into a form with purple flowers**

corresponding figure on Plate 22. This point has been verified by study of the typical material of *A megacarpus* var *caulescens* M E Jones (PO) It should also be noted that the figures of what Jones regarded as typical *A oophorus* on Plate 21 contain a mixture true *A oophorus* is there represented only by the upper pod and section, while the remainder (marked "a," from Mammoth, Utah) are quite characteristic of *A artipes* and in no way separable from the figure of var *caulescens* on Plate 22 A touch of fantasy is added to this labyrinth of confusion by the fact that the material of *A artipes* gathered by Lemmon, Rusby and Toumey in the Flagstaff region of northern Arizona are referred by Jones (*l c* 120) to *A megacarpus* var *Parryi* A Gray, although he noted that they were abnormal in having ochroleucous flowers

Phaca jucunda Jeps and Rydb has since publication been rightly reduced by Dr Jepson himself (Fl Calif 2 348 1936) to *A. oophorus* Apart from the criterion of color, which I believe to be chimerical, Rydberg advanced only the shape of leaflets to distinguish the segregate *P jucunda* from *P oophora* A mere glance at any considerable suite of specimens, however, reveals that the shape of leaflets is in no way correlated with flower-color, with shape of pods or with distribution, for they may vary throughout the range of the species from crowded, suborbicular and retuse through many intermediate stages to remote, narrowly elliptic and acute (as in the Charleston material) and exactly similar variation occurs in *A artipes* Considerable variation occurs also in the length of the stipe and in the size of the corolla

I am disposed, therefore, to regard the whole complex as a single species, of which *A artipes* may be regarded as a well-marked variety, under the combination *A oophorus* var *caulescens* Jones The pertinent literature is summarized in the following synonymy

Astragalus oophorus S Wats var **typicus** Barneby nom nov

A oophorus S Wats, Bot King 73 1871 *A oophorus* sensu M E Jones, Rev Astrag 120, *pro parte*, Pl 21 (as to upper figures) *A oophorus* var *caulescens* M E Jones, *op cit* 121 lin 32 (lapsu), non ibid lin 38 *A. oophorus* var *artipes* M E Jones, *op cit*, Index to Plates and Pl 23, *nomen nudum*, non *A artipes* A Gray *Phaca oophora* (A Gray) Rydb, N Amer Fl 24 338 1929 *P jucunda* Jeps and Rydb, in Rydb, op cit 339 *Astragalus jucundus* Jeps and Rydb ex Peck, Man Pl Oreg 446 1940, *nomen nudum*

Astragalus oophorus S Wats var **caulescens** (M E Jones) M E Jones

A oophorus S Wats var *caulescens* (M E Jones) M E. Jones, Rev Astrag 121, lin 38, Pl. 22, 1923, non ibid, lin 31 *A megacarpus* var *caulescens* M E Jones, Proc Calif Acad Sci II, 5 643 1895 *A artipes* A Gray, Proc Amer Acad 13 370 1878 *A oophorus* sensu M E Jones, Rev Astrag 120, *pro max parte*, Pl 21, fig a, *non* S. Wats *Phaca artipes* (A Gray) Rydb, Bull Torr Cl 32 664 1906, N Amer Fl *l c*

Astragalus straturensis M E Jones

Atelophragma straturense (M E Jones) Rydb *Hamosa atratiformis* Rydb

NEVADA dry slopes among junipers and pinyons, 12 miles east of Panaca, Lincoln Co, alt 7050 ft, 9 May, flor *Ripley and Barneby 4386* Also ibid, 11 June, fruct. *No 4971*

A new record for Nevada The flowers are bright violet-blue when fresh, with a pale, striate diamond in the fold of the banner

This will almost certainly prove to be the same plant as that collected by Vernon Bailey (*Death Valley Exped No 1975*) "about 30 km east of Panaca" in Utah and determined by Sheldon (ap Cov, Contrib U S Nat Herb 4 87 1893) as *A obscurus* S Wats The latter species is not known south of the valley of the Humboldt River and has ochroleucous, not "purplish," flowers

Astragalus eremiticus Sheld var **typicus** Barneby nom nov

A eremiticus Sheld, Minn Bot Stud 1 161 1896, *sensu stricto*

UTAH Gunlock, Washington Co, with ochroleucous flowers *Ripley and Barneby 4298.* ARIZONA Mokiak Pass, Mohave Co, with purple flowers *No 4318* NEVADA Pahranagat Mts, west of Crystal Springs, Lincoln Co, flowers purple *No 4408*

Astragalus eremiticus Sheld var **spencianus** M E Jones, Contrib W Bot 10 60 1902

A boiseanus A NELS, Bot Gaz 53 223 1912 *A arrectus* var *Kelseyi* M E JONES, Rev Astrag 161 1923, *non A Kelseyi* Rydb *Tium eremiticum* (Sheld) RYDB., N Amer Fl 24 390 1929, Bull Torr Cl 57 400 1930, *pro parte*

NEVADA 10 miles west of Elko, Elko Co, in sagebrush *Ripley and Barneby 4588*

The type of this variety, though not specified by Jones, is evidently his collection from Spencemont (? Lander County), Nevada, in 1891 (PO), and is exactly similar to authentic material of *A boiseanus* from the neighborhood of Boise, Idaho Later Jones referred it as a variety to *A arrectus* A Gray, but mistakenly identified it with *A Kelseyi* Rydb which is *A atropubescens* Coult and Fish and not certainly distinct from *A arrectus* Rydberg, in his review of Tium (*l c*, 1930), recognized the differences which exist between typical *A eremiticus* and the var *spencianus*, but was unwilling to separate them Nonetheless the morphological criteria enumerated by him, when considered in the light of factors of distribution and habitat, appear amply sufficient to support a variety. The var *typicus* is endemic to the arid, subdesertic ranges about the common boundary-point of Nevada, Arizona and Utah, always in the drainage of the Colorado River or its immediate tributaries such as the Muddy River or the Virgin, where it occurs on dry, stony slopes in the juniper-pinyon association, sometimes in depauperate sagebrush The var *spencianus*, on the other hand, occupies the interior basin region of northeastern Nevada and adjacent Idaho and Oregon, in the drainage of the Owyhee, Snake and Humboldt rivers, where it is a characteristic element of the flora of sagebrush plains and valleys It is not known to extend south of White Pine County, Nevada, and no intergrades have been seen

Astragalus Bryantii Barneby spec nov

(Plate 17, figs 10–18)

Astragalus Bryantii Barneby spec nov inter *Palantia* generis *Tii* Medic sensu Rydb adnumeranda, habitu pube etc *A mokiacensi* A Gray forsan proxime affinis, sed ab eo consociisque omnibus leguminis angustioris valde compressi sutura ventrali acuta necnon pericarpio tenui diversissima et his notis *Hamosae Tricarinatas* Rydb , a quibus imprimis tubo calycino tubuloso nec campanulato longius distat, simulans

Herba verosimiliter perennis, 'tripedalis' teste cl Bryant, pube e pilis brevibus adscendentibus candidis constituta praeter foliolorum paginam superiorem glabratam undique strigosa, partibus junioribus villosulo canescentibus caulibus ut videtur adscendentibus (sed imis ignotis) plus minusve flexuosis striatis purpurascentibus stipulis deltoideo acuminatis extus strigosis herbaceis vel anguste scarioso marginatis ca 5 mm longis, mox reflexis foliis patulis subsessilibus vel breviter petiolatis, 8–12 cm longis, rachi subtereti strigoso petiolum multoties superanti foliolis 14–20, petiolulo 0 5–0 75 mm longo gestis, ovatis, late ellipticis vel obovatis, 5–14 mm longis, 3–8 mm latis, inferne strigoso canescentibus pedunculis firmis arcuato adscendentibus striatis 4–5 cm longis, in racemum laxum ca 15 florum fructiferum vix elongatum nec folio suffulcranti multo longiorem abeuntibus bracteis lanceolato attenuatis ca 2 mm longis floribus violaceis 15–17 mm longis pedicello arcuato 1 0–2 5 mm. longo saepissime atropiloso suffultis calycis membranacei pilis albis nigrisque commixtis strigosi tubo late cylindrico, 5 mm longo, postice gibbo, ovario in tumescenti mox rupto, dentibus anguste subulatis acutis 1 5–1 75 mm longis coronato vexillo obovato 16 mm longo, ca 8 mm lato, ad medium retrorsus arcuato sed apice profunde emarginato declinato, marginibus reflexis alis ca 14 mm longis, lamina lunata obtusa 1 5–1 75 mm lata, auriculo basali conspicuo incluso 7 mm longa carinae petalis ca 13 mm longis laminis latius lunatis saltem 7 mm longis, 2 5 mm latis, marginibus superioribus profundiuscule concavis, inferioribus (connatis) inferne rectis ad medium abrupte in apicem latum obtusissimum sursum arcuatis legumine horizontaliter patulo vel leviter adscendenti, arcte sessili, 2 loculari, subrecto vel saepius paullum arcuato, ambitu lineari vel lineari lanceolato, 2 0–2 5 (3) cm longo, ad basin rotundato supra medium sensim attenuato, valde compresso, sulco 0 75–1 5 mm alto impresso dorsaliter percurso, sutura ventrali per longitudinem totam prominula, dorsali ad ventralem usque introflexa septum subcompletum 2 0–2 5 mm altum fere in leguminis apicem productum efformanti, valvulis chartaceis tenuiter reticulatis parce strigulosis vel demum glabratis nonnumquam minute purpureo guttulatis, sectione transversali anguste deltoideo obcordata, 3 0–4 5 mm alta, 1 5–3 0 mm lata seminibus oblique reniformibus, 2 mm latis, brunneis

ARIZONA at the head of **Phantom Canyon** in the **Grand Canyon of the Colorado River, Coconino Co** , 15 Dec 1939 Collected by Dr H C Bryant of the National Park Service in whose honor it is named

Type in Herb Calif Acad Sci. No. 293940 Also collected in sand at the mouth of Hermit Creek in the Grand Canyon, 10 April 1917 *Eastwood 5991* (G, F)

The type of *A Bryantii* is apparently part of the collection referred to by Kearney and Peebles (Fl Pl Ariz 486 1942) as representing an undescribed species allied to *A palans* M E Jones, but, although a real affinity may exist between the two, it has been found convenient for purposes of diagnosis to compare it rather with *A mokiacensis* A Gray, with which it agrees more closely in the quality of the pubescence, in the violet, not reddish purple coloration of the corolla, and in the less marked curvature of the legume From *A mokiacensis*, known only from a few localities on either side of the Colo-

rado River immediately below the Grand Canyon, *A Bryantii* differs in the strongly compressed, more slender and sparingly strigose pods which are of thinner texture and spread horizontally from the axis of the raceme Indeed the texture and compression of the pod, with its acute ventral suture, led me at first to regard the species as more intimately connected with forms of *A arrectus* A Gray (*Tium* ser *Arrecta* Rydb) or with *Hamosa* ser *Tricarinatae* Rydb, but the complete absence of stipe and the cylindric calyx-tube make such an alignment improbable, and the species is more naturally associated with *A mokiacensis*

As far as can be seen from the limited material at hand, *A Bryantii* is very constant in vegetative characters, but the shape of the pod is evidently variable Normally, as always in *Eastwood 5991*, the pod is narrowly lance-attenuate in outline, the cross-section at the middle being about 3 mm high Attached to Dr Bryant's specimen, however, there are several loose pods, essentially similar in structure and pubescence but half as broad again, the cross-section being 4 5 mm high and the outline lanceolate, more abruptly acute rather than attenuate at apex Although the plant from which these pods have fallen has not been studied, their measurements are included in the description of the species and they have been treated as an integral part of the type A similar latitude of variation has been found by the writer to occur in a number of species in the genus

Astragalus Pattersonii A Gray, *sens strict*

Jonesiella Pattersonii Rydb

Arizona red clay hills 2 miles east of Fredonia, Coconino Co, alt 4900 ft *Ripley and Barneby 4861*

The specimens are almost exactly typical, with narrowly elliptic, subsessile, strictly erect pods This form of the extremely polymorphic species was known to Rydberg only from Colorado, and has not been reliably reported outside of that state, though a closely allied form with spreading pods is common in the Navajo Basin The *A Pattersonii* of Tidestrom and Kittell (Fl Ariz and N Mex 214 1941), if one may judge from the synonymy, is an aggregate containing a number of diverse forms

Astragalus ensiformis M E Jones var **typicus** Barneby nom nov

A ensiformis M E Jones, Rev Astrag 226 1923 *A ursinus* M E Jones, Proc Calif. Acad Sci II, 5 668 1895, non A Gray *Hamosa ensiformis* Rydb

Arizona gentle stony slopes among junipers in Mokiak Pass, north of Wolf Hole, Mohave Co, alt 5300–5500 ft, 4 May, fl and fr *Ripley and Barneby 4811*

The type-locality of *A ensiformis*, "4 miles above Pagumpa," is very close to our station and the species has been collected elsewhere only by Peebles and Fulton in northern Navajo County (cf Kearney and Peebles, Fl Pl Ariz 488 1942) The name is universally cited as having been published in 1895, but this is incorrect Jones, it is true, described the species quite minutely in that year (*l c*), but under the name *A ursinus* A Gray, merely suggesting *A ensiformis* as an alternative should the plant prove as distinct as he suspected, and the combination was not validly applied until the Revision of Astragalus in 1923 Rydberg, who did not see the flowers, associated *A ensiformis* with *A Congdonii* S Wats and *A drepanolobus* A Gray, whereas, with its tubular calyx and enlarged, scarious stipules, it clearly belongs to his series *Malacae* of *Hamosa* and is closely related to *A Minthorniae* (Rydb) Jeps In fact a collection from southern Utah, described below as a new variety, forms a passage between the two

Astragalus ensiformis M E Jones var **gracilior** Barneby var nov

(Plate 17, fig 28)

Astragalus ensiformis M E Jones var *gracilior* Barneby var nov a var *typico* nob caule internodiis extensis duplo elatiori, floribus post anthesin haud deflexis, racemo fructifero minime secundo et praesertim legumine graciliori minus compresso patule erecto evidentius hirsutulo nec appresso striguloso diversa Ab affini *A Minthorniae* (Rydb) Jeps, cujus habitum in memoriam nonnihil redigit, imprimis legumine magis arcuato haud dense sericeo villoso facile separanda

UTAH in stiff soil among sagebrush, **5 miles south of Veyo, Washington Co**, alt 4900 ft *Ripley and Barneby 4951* *Type* in Herb Calif Acad Sci No 300418

So different was the superficial appearance of this variety from that of *A ensiformis* var *typicus* that it was thought in the field to represent an undescribed species, but subsequent study has shown that the differences, though striking, are not fundamental, and it cannot be specifically separated In the typical form the decumbent stem, with congested internodes, does not exceed 15 cm in length, the fruiting raceme is strongly secund, the flexuous pedicels are arcuate-reflexed and the sparingly strigose pods, though arched upwards, are essentially pendulous The stems of the var *gracilior,* on the other hand, are upright and slender, reaching a height of 3 dm, the raceme is not at all secund, while the more finely and densely pubescent pods are held erect or somewhat spreading on straight and rigid pedicels There is no appreciable difference in the form of the flowers, though in the var *typicus* they are reflexed after fertilization

Astragalus chamaemeniscus Barneby

NEVADA In sand under sagebrush near the Geyser Ranch, N Lincoln Co, alt 6050 ft, 11 May, flor *Ripley and Barneby 4416.*

This species was known previously only from extreme northeast Nye and adjacent White Pine counties in the valley of the White River

Astragalus Arthu-Schottii A Gray, *sensu restricto*

A Arthu Schottii A GRAY, Proc. Amer Acad 6 209 1863, pro max parte, non op cit 7 337 1867 *A Coulteri* sensu S WATS, Bot King, 66, 435 1871, A GRAY, Bot Calif. 1 146 1880, SHELD, Minn Bot Stud 1 140. 1894 et auct mult. pro parte, quoad syn, non Bth *A lentiginosus* var *borreganus* M E JONES, Contrib W Bot 8 8 1898, Rev Astrag 126, tab 25 1923 *A lentiginosus* var *Coulteri* sensu JONES, Rev Astrag

127 quoad syn., Jeps., Fl. Calif. 2: 357. 1936, quoad syn. et pl. cit. Schott. *A. agninus* Jeps., Man. Calif. 577. 1925, Fl. Calif. 2: 355. 1936; Harrison and Kearney, Journ. Wash. Acad. Sci. 22: 227. 1932; Munz, Man. S. Calif. Bot. 270. 1935; Kearney and Peebles, Fl. Pl. Ariz. 487. 1942. *Cystium Arthu-Schottii* (A. Gray) Rydb., N. Amer. Fl. 24: 407. 1923. *C. agninum* (Jeps.) Rydb., loc. cit. 408.

Study of the somewhat elaborate synonymy and literature cited will show that *A. Arthu-Schottii* is believed to be the oldest valid name for the plant which has been described and treated in comparatively recent years as *A. lentiginosus* var. *borreganus* Jones and *A. agninus* Jeps., and, while reasons might be advanced for discarding Dr. Gray's name as a permanent source of error and confusion, a reexamination of the facts tends to support its revival into current use. *A. Arthu-Schottii* was first encountered by Schott during the exploration of the Mexican boundary in 1855, but his collections were not cited by Gray in the Botany of the Survey, doubtless because the specimens available to him were without fruit. Several years later, having received from Fremont additional material of what he took to be the same, Gray decided to publish the species, including in his concept a plant collected in northern Sonora by Capt. Smith. Thus the original *A. Arthu-Schottii* was founded on three elements, cited by Gray (*l. c.*) in the following words: "on the Mohave River, Fremont, 23 April. Diluvial banks of the Colorado near its mouth, 12 March, Schott. Boca Grande, Capt. E. K. Smith.", and each of which belonged to a different species. The Fremont specimen (NY) is a very depauperate, first-year individual of that form of *A. Coulteri* Bth. with small corollas which is common on the Mohave Desert of California and which is variously treated in modern literature as *A. lentiginosus* var. *Coulteri* or var. *Fremontii*; the Schott element, as will be established below, belongs to *A. agninus* Jeps.; while the material from Boca Grande, a fragmentary specimen with leaflets glabrous on the upper surface, though not susceptible of certain determination, is probably a form of *A. lentiginosus* var. *yuccanus* Jones (certainly not *Cystium eremicum* as annotated by Rydb.). In settling on the type of *A. Arthu-Schottii* the latter may be quickly discarded: not only was it cited last by Gray, but the only reference to it in the description seems to be "*foliolis . . . pagina superiore interdum glabrata,*" and it must have formed a quite unimportant part of the species that the author had in mind. The choice between the Fremont and Schott elements, however, is more difficult, for the description fits both with almost equal exactness. Nevertheless the phrases dealing with the calyx—"*calycis dentibus subulatis tubo oblongo-campanulato vix dimidio longioribus*"—and with the keel—"*carina majuscula subrecta vexillo paullo breviore*"—are matched more closely by the corresponding organs of Schott's plants than by those of Fremont's and the description seems to have been prepared primarily from the former, the first collected and more copious specimens. For this reason, as well as to avoid the anomaly of excluding from the species named in honor of Schott the very elements which he himself collected, it seems proper to regard the Boundary Survey No. 256 in herb. Gray as the type.

As stated above, the material of *A Arthu-Schottii* available to Gray was without fruit, and this is true both of the sheet now in herb Gray as well as of the two in the Torrey herbarium (NY) In the Field Museum, however, there are three additional isotypic sheets, apparently from Schott's private herbarium, one of which has nearly mature legumes and belongs, quite incontestably, to *A agninus* Jeps Even without this further evidence the identity of Schott's plant would be almost certain from locality alone The six sheets seen by the writer are variously annotated "Colorado Desert near Fort Yuma," "Colorado Desert, Sonora" and "Between San Diego and the Colorado," and whether or not these represent one or more separate gatherings it is clear that all came either from extreme southern Imperial County, California, or from closely adjacent Sonora, a territory from which *A Coulteri* is totally unknown yet where *A agninus* has been frequently collected Nevertheless, starting with Watson in 1871, the Schott collection has been regularly determined by all students of the genus as *A Coulteri* and is so annotated by Sheldon (NY) and cited by Jones and Jepson The error is perhaps traceable back to Gray's publication, as early as 1867, (*l c*), of a revised description of *A Arthu-Schottii* taken from fruiting material communicated by Cooper from the Mohave Desert ("Camp Cady and elsewhere," G) which is conspecific with the early Fremont collection but not with that of Schott, i e *A Coulteri* var It should be borne in mind that, at the time when Gray proposed *A Arthu-Schottii, A Coulteri* was known to him only from Bentham's description, and it is not surprising therefore that, when *A Coulteri* was finally identified with the Cooper plant in fruit, the whole of *A Arthu-Schottii* was also thought to belong there

In the North American Flora (*l c*) Rydberg abandoned the accepted interpretation of *A Arthu-Schottii,* recognizing it as a species in the genus *Cystium,* but the effect is somewhat marred by the fact that he recognized *Cystium agninum* and *C Coulteri* as well If one may judge from specimens in the New York Botanical Garden so annotated by Rydberg himself, his *C Arthu-Schottii* contained, in addition to the original Schott collection (which he also regarded as typical), a number of plants from the Mohave Desert such as *Parish 4957, Elmer 3641,* etc , which are inseparable from the early Fremont collection, although that actual specimen he referred to *C Coulteri* (Bth) Rydb ! It should also be remarked that in the same work (*l c , in syn*) Rydberg incorrectly cited *A lentiginosus* var *borreganus* as having been published by Jones in the Revision of Astragalus, whereas it actually had appeared as early as 1898 (cf *supra*) and in addition failed to note Jones' excellent figure

A Arthu-Schottii is a plant of rather restricted distribution in the southwestern deserts from interior San Diego County, California, at Borrego Wells, *Orcutt,* type of var *borreganus* (PO), *Jepson 8883,* type of *A agninus* (NY, fragments), to Yuma, Arizona, *Beckett & Nobles 8695* (G, F), southward just into Sonora about San Luis, *Harrison & Kearney 8434* (F), and north along the Colorado River to eastern San Bernardino County, California, at

Silver Lake, *J. T Howell 3586* (CAS) and Nipton on the borders of Nevada, *Ripley & Barneby 3360* The species is very closely allied to *A Coulteri*, which it replaces south of the Coachella Valley, but differs in the annual root, lax fruiting racemes and scarcely inflated pod

Astragalus lentiginosus Dougl var **cæsariatus** Barneby var nov

(Plate 17, figs 29–30)

Astragalus lentiginosus Dougl var *cæsariatus* Barneby var nov inter *Cystia* neogea Rydbergiana sive *Astragali Diphysos* A Gray adnumeranda, caulibus prostratis, floribus congestis et legumine coriaceo *A tehatchapiensi* (Rydb) Tidestr proxime affinis, sed ab eo floribus maximis ca 19 mm longis saturate violaceis, dentibus calycinis longioribus acutis, legumine abruptius acuminato necnon racemorum axi calycibus bracteisque pube e pilis nigris laxius appressis constituta crebre indutis, satis superque diversa *A lentiginosus* var *nigricalycis* M E Jones, qui etiam in iisdem finibus passim occurrit, caulibus paucis elatis, racemo laxiori, floribus minoribus saepissime ochroleucis, pube crispa implexa et legumine omnino albo villosulo nec partim atro strigoso a nostra distantius recedit

CALIFORNIA grassy slopes of the **Temblor Range above McKittrick, Kern Co**, alt 2900 ft, 13 April, fl and fr *Ripley and Barneby 3243* *Type* in Herb Calif Acad Sci No 289572

The proposed variety is here referred to *A lentiginosus—sensu latissimo—* in order to fit into Dr Jepson's treatment of this complex group in the Flora of California, but the disposition is probably not final The writer has spent many months in study of *A lentiginosus* and its allies and it is now believed that a taxonomic arrangement based on a specific concept intermediate between the extremes of Rydberg, who recognized 33 species in *Cystium,* and of Jones, who regarded all the known races as varieties of *A lentiginosus,* is not impossible In spite of the fact that the specific limits would be somewhat blurred, it would appear feasible to recognize at least three major species, *A lentiginosus, A Coulteri* Bth and *A diphysus* A Gray (approximately corresponding with Rydberg's three series *Lentiginosa, Coulteriana* and *Diphysa* of *Cystium*), under which the remainder, with several as yet undescribed, might reasonably be classified as varieties In this case the var *cæsariatus* would be referred to *A diphysus* and associated closely with *A tehatchapiensis* (Rydb) Tidestr (Proc Biol Soc Wash 50 21 1937, as *tehachapiensis*) yet easily separable by the larger, brilliantly colored corolla, acute calyx-lobes, sinuous stems, and by the pubescence of loosely appressed black hairs which invest the whole axis of the raceme, the pedicels and calyces, and which recur, mixed with white villi of similar structure, on the valves of the more abruptly cuspidate pod *A lentiginosus* var *nigricalycis* M E Jones, the common race of the San Joaquin Valley, differs from ours in its taller stems, more lax racemes of smaller ochroleucous flowers, and by the tangled, curly pubescence of the stem, herbage and legume, the valves of which are larger and of thinner texture

A. lentiginosus var. *caesariatus* is not uncommon on the eastern slope of the Temblor Range, where it forms large clumps among the ephemeral spring grasses, many annuals characteristic of the flora of the Great Valley foothills, and such perennial herbs as *Senecio Breweri* Davy and *Delphinium hesperium* var *recurvatum* Jeps The stems, arising from a heavy root and multicipital caudex, are very numerous, reclinate below but with ascending tips, and the subcapitate or short and dense racemes of large purple flowers with their contrasting striate eye on the banner make the variety one of the showiest of California *Astragali* The specific epithet is derived from the Latin '*caesaries*' and refers to the abundance of dark hairs in the inflorescence

Astragalus striatiflorus M E Jones, Proc Calif Acad Sci II, 5 643 1895

(Plate 17, figs 19–24)

UTAH locally abundant in white sand and on rock ledges beneath sandstone cliffs, 10 miles north of Johnson Ranch, east of Kanab, Kane Co, alt 5600 ft, 6 May, flor *Ripley and Barneby 4368* Ibid, 5 June, fl and fr *No 4816* Also beneath the white cliffs 5 miles south of Zion Park Junction, Kane Co, alt 6100 ft *No 4365*

This exceedingly obscure species has been known up to the present only from an inadequate fragment, devoid of pods, which was gathered by Jones "in red sand, above Springdale" (the western entrance to Zion Park, Washington County, Utah) in September, 1894 The type collection, Jones 6080k (PO), consists of a single very mature plant from which even the flowers have now fallen The characteristic habit, however, the pubescence and curiously connate stipules still visible in the dried material, when taken in conjunction with the description of the flower and its attenuate keel, leave little doubt that our recent collections are determined correctly. Jones was apologetic about describing a species of *Astragalus* without knowledge of the fruit, but, convinced by the floral and other peculiarities of his material that he had before him a species "certainly belonging to the *Inflati* and probably near to *A serpens*" (*l c*), he was unable to resist giving it a name That his proposition was valid is now obvious, but in referring *A striatiflorus* to the *Inflati* (approximately the genus *Phaca* as defined by Rydberg) Jones was far from the mark · actually the pod, while inflated, is bilocular and the affinity of the plant is probably with *A platytropis* A Gray In the text of the Revision of Astragalus the species is not mentioned, but in the Index (which is not paginated) it is reduced without comment to *A Sileranus* M E Jones, a true member of the *Inflati* with discrete stipules, quite different flowers and elongated stems Rydberg, to whom the species was entirely unknown, cited *A striatiflorus* in his list of omitted synonyms in *Astragalus* (N. Amer Fl. 24:455. 1929), and could do little else but follow Jones' earlier reduction. As the species remains virtually undescribed to this day, it has been thought advisable to prepare a revised description with emphasis on the floral and carpological characters.

Astragalus striatiflorus M E Jones, char. fruct

A low cespitose perennial herb with a fleshy taproot and loosely branched subterranean caudex, the stems and herbage densely and softly villous-canescent with white spreading and somewhat curly hairs Stems very short, decumbent, clothed below with loosely imbricated stipules, the upper 2 or 3 internodes about 1 cm long Stipules very broadly obovate, truncate and often mucronate, 2–3 mm long, scarious and many-nerved (the nerves more or less anastomosing), adnate neither to the stem nor to the petiole but connate around both to form a cup, strigose villous without. Leaves 2–3 cm long, the slender rachis and petiole subequal Leaflets 11–13, petiolulate, obovate to oblanceolate, obtuse, truncate and mucronulate or rarely a little emarginate, often conduplicate, contiguous, the terminal smallest Racemes short, loosely 3–5 flowered, on peduncles about equalling the leaves Bracts ovate, acute or acuminate, scarious, longer or shorter than the spreading pedicels Calyx purplish, villous hirsute with white or some black hairs, the tube campanulate or obscurely obconic, 3–4 mm long, oblique at the orifice, the acute teeth 2–3 mm long, hetero morphous, the ventral pair deltoid acuminate, the lateral pair and the dorsal one linear subulate. Corolla 9–12 mm long, ochroleucous or suffused with lavender, the banner striate with purple lines and the keel deeply purple-tipped Banner with suborbicular blade 8–9 mm broad, narrowed into a very short claw, arcuate much below the middle nearly to a right angle, the margins spreading but not reflexed Wings 8–9 mm. long, the blades lunate obtuse, about 2 mm broad, including the large basal auricle 6 mm long Keel petals equaling the wings, the blades 6–7 mm long, obliquely lanceolate and arcuate upwards, strongly gibbous above the claw and there attached to the wings, the upper margins concave at the middle, the lower margins straight below, toward the middle abruptly convex and arched upward to the slightly declined apex of the long attenuate but obtuse beak, free for 1 mm below the summit Style filiform, at full anthesis exserted about 1 mm from the keel, geniculate below the capitate stigma Pod bladdery inflated, bilocular, 12–15 mm long, spreading, sessile but seated on a minute boss within the calyx and readily deciduous therefrom, in outline broadly ellipsoid, rounded and somewhat oblique at base, abruptly acute and apiculate at the apex which is crowned by the coiled persistent style, shallowly sulcate along either suture, the ventral suture nearly straight, filiform, the dorsal intioflexed to form a thin double partition 3 mm high produced across the entire width of the cavity, the valves membraneous, densely villous with white curled spreading hairs, mottled with purple, the cross section suborbicular 6–7 mm broad and a little less high, emarginate at the sulcate sutures Seeds about 8 in either locule, obliquely reniform, compressed, about 2 mm long, olive green

A striatiflorus is set off from all known species of *Astragalus* by a combination of characters which excludes it from a place in any natural group hitherto defined An attempt to determine the species from Rydberg's monograph leads the enquirer directly to *Cystium platytrope* (A Gray) Rydb, or, more deviously, to *A anisus* M E Jones, but the similarity between these plants is, I believe, rather superficial and based entirely on the structure of the pod In the present paper it is not proposed to discuss the taxonomic position of *A anisus*, which differs (*inter alia*) from *A platytropis* and *A striatiflorus* in the elongate flower and cylindric calyx-tube and which is probably correctly placed by Jones and Rydberg as an aberrant relative of the ***Mollissimi*** (*A mollissimus* Torr et spp affin) But the differences between the two last and the relationship of each to *A lentiginosus* sens latiss, i e ***Cystium*** of Rydberg, will be examined in more detail

It has already been implied that a similarity between the pods of two given species of *Astragalus* is not necessarily a criterion of affinity, but this assertion must be amplified, for, thus baldly stated, it stands in direct contradiction to Rydberg's most important principle of classification. All of Rydberg's later work on the genus, which culminated in his monographic revision for the North American Flora, is based on the primary assumption that carpological characters, even when of the most minute and quantitative nature, are of supreme value in the definition of groups or, in his terminology, of genera. Diversity in structure of the flower, stipules or pubescence he discarded as of quite secondary importance. By logical application of this principle, Rydberg was led to assume an affinity between species, scattered perhaps from the Levant to the Andes, which happened to have a similar width of septum in the pod, yet simultaneously to refer to widely separated groups two species intimately connected by ties of morphology and geography in which the septum was found to be strongly or weakly developed. Of course this method was satisfactory in parts, for many allied species do, as one would expect, bear similar pods, but in some cases it produced polyphyletic groups of great artificiality. Had Rydberg himself admitted this, it could be easily forgiven. But interior evidence from his published writings leaves little doubt that he proposed his genera as genuine phylae, as evolved expressions of a single heredity marked by a carpological structure common to all included members. And implicit in that belief was the conclusion that any two members of one genus are more closely related to each other than either can be to a member of another genus. With this principle in mind let us take an example from Rydberg's own work.

Tium Wilsonii (Greene) Rydb. is a species of *Astragalus* endemic to the high plateaux of northern Arizona, described by Greene as related to *A. diphysus* A. Gray (*Cystium diphysum* Rydb.) and reduced by Jones in synonymy to a variety of *A. lentiginosus* Dougl. The pod is lanceolate, leathery, slightly but not conspicuously inflated, with the valves introverted dorsally to form a partition and thus partially bilocular. The septum does not quite reach the ventral suture, but the gap is not above one millimeter in width. With this we may compare *Cystium agninum* (Jeps.) Rydb., discussed elsewhere in this paper. Here we have a pod of similar outline, little inflated, but the septum traverses the whole width of the cavity (sometimes less: cf. Jeps. ex char. "... extending half way or nearly to the ventral suture") and the gap between the sutures is as a rule closed. Rydberg rightly disregarded the lack of inflation in the fruit of *C. agninum*, otherwise anomalous in his genus *Cystium*, yet attached sufficient importance to the equally quantitative character of the septum to refer *A. Wilsonii* to *Tium*, and we are led to believe that despite their manifest similarity in all other respects to *A. coulteri* and *A. diphysus*, both Rydbergian *Cystia*, these two species of the southwestern states are more closely related to, respectively, the old-world *A. Cicer* L., genotype of *Cystium* and *A. sulcatus* L., genotype of *Tium*, than they are to one another.

This relationship is not, of course, ipso facto, impossible. But once the relationship is admitted we must also accept that the evolution of the septum stopped abruptly at an incalculably distant date and has since been stationary, while the differentiation of species has continued along other lines However, when the marvelously diverse carpology of *Astragalus* is considered as a whole, and when one recollects the manner in which the pods of species accepted by Rydberg himself as closely allied may differ in size and shape, in length of stipe, in the degree of compression and inflation, and even (cf *Tium platycarpum* and *T racemosum*) in the very width of septum, it becomes clear that all parts of the fruit have been equally subject to evolutionary progress and recession in comparatively recent times Indeed there seems to be no reason why the similarity of structure between the pods of Old and New World species, remarked by Rydberg and other taxonomists before him, cannot be explained as well by parallel development as by a common heredity In this case no single carpological character, nor even general agreement in structure of the fruit, can be accepted as a reliable basis of a natural classification throughout the genus unless supported by other criteria of proved value and the names of generic segregates such as *Cystium* and *Tium,* founded on European or Asiatic species, have a very questionable place, whether applied to genera, subgenera or sections, in the taxonomy of American *Astragalus.*

From this statement of generalities we may well return to the particular subject of the present note, *A striatiflorus* and its immediate allies In the interests of clarity the major characters of the species are contrasted in the following table with *A platytropis* and *A lentiginosus*

	A striatiflorus	*A platytropis*	*A lentiginosus*
Stems	shortly caulescent	subacaulescent	strongly caulescent
Pubescence	villous	loosely strigose	strictly appressed
Stipules	connate around stem and petiole	connate abaxially about the petiole	free or obscurely adnate to petiole
Keel	lance attenuate equalling wings	oblong truncate equalling wings	lunate obtuse shorter than wings
Style	exserted	included	included
Pod, bilocular and inflated	with septum formed by intrusion of dorsal suture, the ventral filiform	with septum formed by a narrow inflexion of the dorsal suture and a deeply produced wing from the ventral which extends below the insertion of the funicles	with septum formed as in *A striatiflorus,* the ventral suture sometimes (especially in allied species) very narrowly introflexed but never below insertion of funicles

It will be seen at once that *A striatiflorus* differs from its supposed allies (or, more precisely, from other species with bilocular, inflated pods) in the attenuate keel, exserted style, stipules and pubescence, and additionally from *A platytropis,* of which it has nearly the habit, in the structure of the septum *A platytropis* (plate 26, figs 25–28), on the other hand, is unique in the concretion of the stipules, in the septum and broadly truncate keel In the opinion of the writer the sum of characters peculiar to each isolates these species so fundamentally from the rest of *Astragalus* as to entitle them to rank as representative of sections in the genus. The following names are therefore proposed

Astragalus sect *Orocystium* Barneby sect nov *Cystium* ser *Platytropia* Rydb , N Amer Fl. 24 405 1929.

Legumen vesicario inflatum, sutura dorsali anguste introplicata ventralique intus producta dimidiam loculi altitudinem superanti biloculare carina oblongo truncata stipulae circa petiolum abaxialiter concretae, altrinsecus liberae Species unica *A platytropis* A Gray

Astragalus sect *Cystiella* Barneby sect nov

Legumen vesicario inflatum, sutura dorsali introflexa biloculare stylus ad anthesin exsertus carina attenuata stipulae multinerviae utrinque concretae cupuliformes Species unica *A striatiflorus* M. E Jones.

Following the conclusion reached above that the New World species referred to *Cystium* by Rydberg are probably not allied to the original elements of Steven, and as this group has no acceptable sectional name in the form of a substantive, I also propose

Astragalus sect *Diplocystium* Barneby nom et. stat nov *Astragalus* ser *Astragalus* sect *Diphysi* A Gray, Proc Amer Acad 6 192 1863 *Astragalus* ser *Eu astragalus* sect *Lentiginosus* Sheld , Minn Bot Stud 1 168 1894, exclus spp plur *Cystium* Rydb , Bull Torr Cl 32 659 1905, N Amer Fl 24 405, sequ 1929, exclus *C platytropide* Amer Journ. Bot 17 232 1930, non *Cystium* Stev , nec *Astragalus* subgen *Cercidothrix* sect *Cystium* Bge *Astragalus* sect *Inflati* M E Jones, Rev Astrag 123, sequ 1923, quoad sp ultimam p max p *Astragalus* subgen *Diphysus* Tidestr , Contrib Nat Herb 25 315 1925 Species typica *A lentiginosus* Dougl ex Hook

While some pains have been taken to point out what are believed to be fundamental differences between these three sections, the converse and, I suppose, more valuable task of tracing their origin and real place in the genus cannot be attempted here In the absence of exact cytological data such speculation is apt to be valueless and in any case is not susceptible of proof I am inclined to suspect, nevertheless, that *Diplocystium* is derived from a common source with the *Mollissimi* *Orocystium* and *Cystiella* seem to be more closely connected with each other than with any known species, but, in associating *A platytropis* with *A cobrensis* A Gray, Jones may have hit on a real line of affinity

EXPLANATION OF PLATE

PLATE 17

Figs 1–9 *Astragalus musimonum* Barneby, spec. nov (1) Pod × 2 (2) Cross section of pod × 3 (3) Flower × 2 (4) Calyx × 2. (5) Banner × 2. (6) Wing petal × 2 (7) Keel × 2 (8) Leaf × 1 (9) Stipules × 2

Figs 10–18 *Astragalus Bryantii* Barneby, spec nov. (10) Pod × 1 (11) longitudinal cross section of same × 1 (12) transverse section of same × 3 (13) Pod of broader type × 1 (14) transverse section of same × 3 (15) Flower × 2. (16) Wing petal × 2 (17) Keel × 2 (18) Leaf × 1

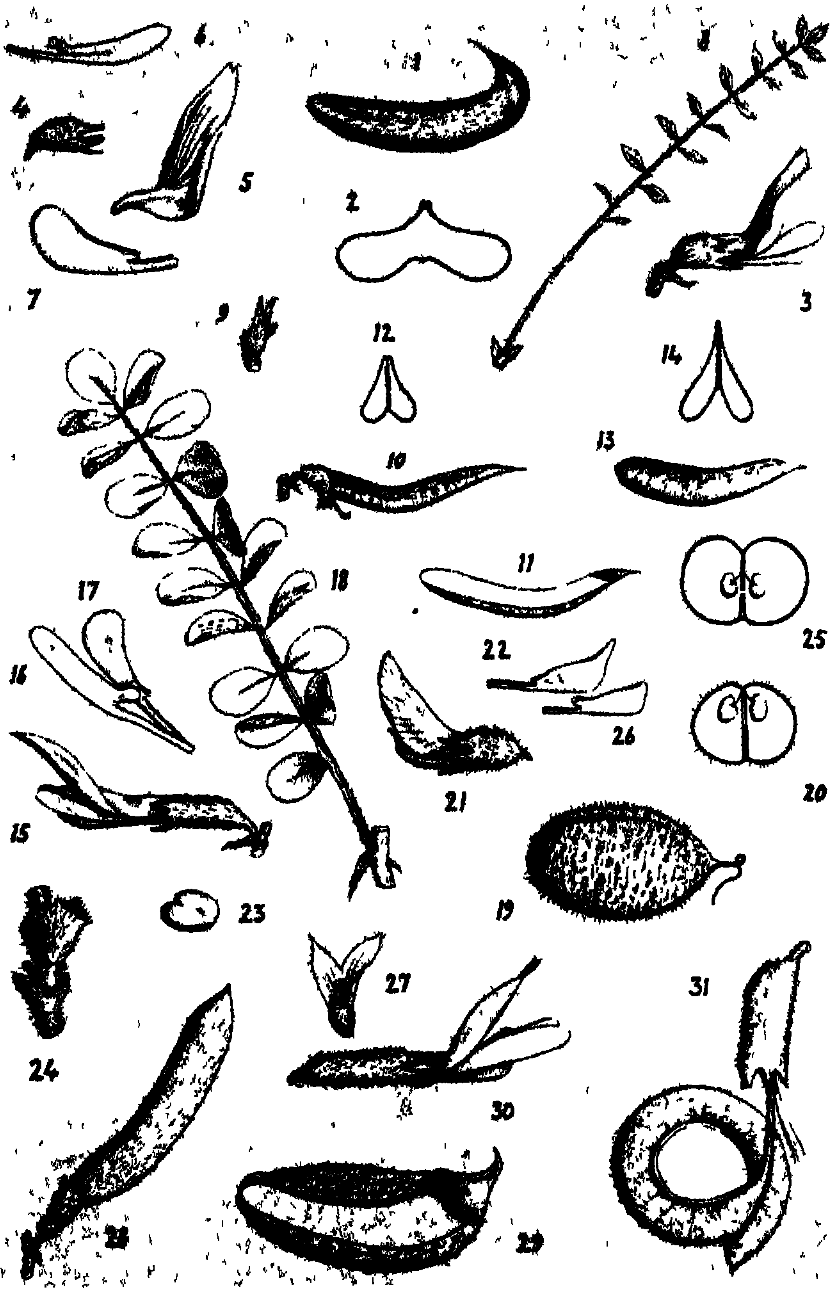
Figs 19–24 *Astragalus striatiflorus* M E Jones. (19) Pod × 2 (20) Cross section of pod × 2 (21) Flower × 2 (22) Keel × 2 (23) Seed × 4 (24) Stipules × 3

Figs. 25–28 *Astragalus platytropis* A Gray (25) Cross section of pod × 1 (26) Keel × 2 (27) Stipules × 3

Fig 28 *Astragalus ensiformis* var *gracilior* Barneby, var nov (28) pod × 1½

Figs 29–30 *Astragalus lentiginosus* var *cæsariatus* Barneby, var nov (29) Pod × 1½ (30) Flower × 1½

Fig. 31 *Astragalus Whitedii* fma *speirocarpoides* Barneby fma nov (31) Pod × 2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No. 4

SUBLITTORAL MARINE ALGAE OF THE MONTEREY PENINSULA

BY
GILBERT M SMITH
Professor of Biology (Botany), Stanford University

Numerous investigations have been made on the marine algae of the Pacific Coast of North America but attention has been directed almost exclusively to those collected in the intertidal zone Statements concerning sublittoral algae (those growing below extreme low tide level) have been based upon the assumption that algae found cast ashore on the beach and not known to grow locally in the intertidal zone must have come from deep water Here and there in the literature is mention of a few algae dredged along the western shores of North America The only exception is the region in the vicinity of Friday Harbor, Washington, where there has been an intensive exploration by dredging Of the 126 species of red algae that Kylin (1925) records from this area, 75 were found only in the intertidal zone, 33 were found only by dredging, and 18 were found both in the intertidal zone and in deep water (5–10 fathoms).

For several years I have been engaged upon a survey of the marine algae of the Monterey Peninsula, California In addition to collecting intensively in the intertidal zone, numerous collections have been made from a depth of 15–60 feet below the extreme low tide level At the time this investigation was commenced the only definite records of sublittoral algae from the Monterey Peninsula were the following *Dictyoneuropsis reticulata* (Saund) G M Smith by Saunders (1895), *Myriogramme spectabilis* (Eaton) Kylin by Nott (1900), *Macrocystis pyrifera* (L) C A Ag and *Nereocystis Luetkeana* (Mert) Post and Rupr by McFarland (1912), and *Lithothamnion montereyicum* Foslie by Foslie (1906)

The first collections from the sublittoral by the writer were made with the assistance of three students (Vernon Brock, Charles Danforth, and Herbert Armstrong) in the summer of 1934 By means of a diving helmet, several algae were collected from a depth of 15–35 feet in the vicinity of Mussel Pt Since 1934 all collections from deep water have been by dredging from a small boat equipped with a 20-horsepower engine The only really favorable place for dredging is the submerged shale reef lying at a depth of 30–35 feet a quarter mile east of the municipal wharf at Monterey Here the rock is so soft that large pieces of rock with algae attached to them are broken loose by the dredge Elsewhere on the Monterey Peninsula the rock on the ocean bottom is granitic and it is extremely difficult to break off pieces with the dredge Here, also, the ocean bottom is so rough that the dredge is continually catching between the rocky crags, and on any dredging expedition one can expect to spend at least half the time trying to dislodge the dredge In spite of these difficulties the sublittoral region between Mussel Pt and Pt Pinos has been rather thoroughly explored So, also, has the land-locked cove (Stillwater Cove) adjoining Pebble Beach No attempt has been made to dredge between Pt Pinos and Cypress Pt because of the danger in taking a small boat close to the shore in this wave-swept portion of the coast line

When blades of algae are found loose in the dredge there is always the problem of distinguishing between those from plants growing in the sublittoral and those broken off from intertidal plants and lying unattached on the ocean bottom For this reason every effort was made to obtain intact plants attached to pieces of rock and thus know with certainty that the alga is from the sublittoral In the following list of algae from the sublittoral one or more specimens of all the species have been found attached to rock dredged from the ocean bottom Some of the algae brought up by the dredge are not found in the intertidal zone of the Monterey Peninsula, or are known only from isolated individuals collected there These are considered true sublittoral algae Other of the algae are regularly found in the intertidal zone These are interpreted as algae the upper limit of whose vertical distribution is approximately the mean low tide level For the sake of comparison the occurrence or non-occurrence in the intertidal zone of the Monterey Peninsula is given for each of the species, as is also the intertidal range with respect to mean low tide level

PHAEOPHYTA

ECTOCARPALES

Ectocarpus granulosus (J E Smith) C A Ag At 30–35 feet near municipal wharf, Monterey, at 15–20 feet, Stillwater Cove Common between the 0 5 and –1 5 foot tide levels

SPHACELARIALES

Sphacelaria didichotoma Saund At 15–20 feet, Stillwater Cove Known from the intertidal zone.

DESMARESTIALES

Desmarestia linearis Gardner mss. At 60 feet near Monterey. Not known from the intertidal zone.

Desmarestia herbacea (Turn.) Lmx. At 30–35 feet near municipal wharf, Monterey. Common between the 0.5 and –1.5 foot tide levels.

PUNCTARIALES

Stictyosiphon tortilis (Rupr.) Reinke. At 30–35 feet near municipal wharf, Monterey. Not known from the intertidal zone.

LAMINARIALES

Dictyoneurum californicum Rupr. At 25 feet near Mussel Pt., at 15–20 feet, Stillwater Cove. Common between the 0.5 and –1.5 foot tide levels.

Dictyoneuropsis reticulata (Saund.) G. M. Smith. At 30–35 feet near municipal wharf, Monterey, at 20–25 feet near Pt. Aulon. Not known from the intertidal zone.

Nereocystis Luetkeana (Mert.) Post. and Rupr. Numerous beds growing at a depth of 30–50 feet. Isolated plants found between the 0.0 and –1.5 foot tide levels.

Macrocystis pyrifera (L.) C. A. Ag. Numerous beds growing at a depth of 30–50 feet. Not known from the intertidal zone.

Pterygophora californica Rupr. Growing in extensive stands at a depth of 20–60 feet between Cypress Pt. and Pescadero Pt. Isolated plants found between the 0.0 and –1.5 foot tide levels.

FUCALES

Cystoseira osmundacea (Menzies) C. A. Ag. At 20–35 feet near Mussel Pt. and near Pt. Aulon. Common between the 0.0 and –1.5 foot tide levels.

RHODOPHYTA

BANGIALES

Goniotrichum elegans (Chauv.) Zanard. At 35–40 feet near municipal wharf, Monterey, at 25–30 feet near Mussel Pt., at 20–25 feet near Pescadero Rock. Isolated plants collected at mean low tide level.

Goniotrichopsis sublittoralis G. M. Smith. At 30–35 feet near municipal wharf, Monterey. Not known from the intertidal zone.

Erythrotrichia carnea (Dillw.) J. G. Ag. At 30–35 feet near municipal wharf, Monterey, and near Pt. Aulon. Common between the 2.0 and –1.5 foot tide levels.

NEMALIONALES

Rhodochorton concrescens Drew. At 25–30 feet near Pt. Aulon; at 35–40 feet near Pt. Pinos. Known from the mean low tide level.

Rhodochorton Amphiroae Drew. At 25–30 feet near Pt. Aulon. Known from the mean low tide level.

CRYPTONEMIALES

Pikea pinnata Setch At 30–35 feet near municipal wharf, Monterey, at 35–40 feet near Mussel Pt Isolated plants found between the 0 5 and -1.5 foot tide levels.

Pikea californica Harv At 20–25 feet near Pt Aulon Widespread but scarce between the 0 0 and -1.5 foot tide levels

Peyssonnelia pacifica Kylin At 30–35 feet near municipal wharf, Monterey, at 20–25 feet, Stillwater Cove Fairly common between the 0 0 and -1 5 foot tide levels

Lithothamnion montereyicum Foslie At 70 feet near Monterey. Not known from the intertidal zone.

Bossea Orbigniana (Dcne) Manza. At 30–35 feet near municipal wharf, Monterey; at 20–25 feet near Pt Aulon Not known from the intertidal zone

Calliarthron Setchelliae Manza At 20–25 feet near Pt Aulon, at 30–35 feet near Pt. Pinos Common between the 0 0 and -1 5 foot tide levels

Halymenia californica Smith and Hollenb At 30–35 feet near municipal wharf, Monterey Not known from the intertidal zone

Prionitis lanceolata Harv At 40–60 feet near Mussel Pt , at 20–25 feet near Pt Aulon and at Stillwater Cove Abundant between the 1 0 and -1 5 foot tide levels

Callophyllis marginifructa Setch and Swezy At 30–35 feet near municipal wharf, Monterey, at 12–15 feet near Pt Aulon, at 15–20 feet, Stillwater Cove Scarce between the 0 0 and -1 5 foot tide levels.

Callophyllis megalocarpa Setch and Swezy At 15–20 feet near Mussel Pt and at Stillwater Cove. Scarce between the 0 0 and -1 5 foot tide levels

Callocolax neglectus Schmitz At 30–35 feet near municipal wharf, Monterey Not known from the intertidal zone

GIGARTINALES

Schizymenia pacifica Kylin At 30–35 feet near municipal wharf, Monterey Common between the 0 0 and -1 5 foot tide levels

Agardhiella Coulteri (Harv) Setch At 20 feet near Mussel Pt and at Stillwater Cove Abundant between the 1 0 and -1 5 foot tide levels

Plocamium pacificum Kylin At 20–25 feet near Pt Aulon and near Pescadero Rock Common between the 0 0 and -1 5 foot tide levels

Gracilaria Sjoestedtii Kylin At 30–35 feet near municipal wharf, Monterey at 40–60 feet near Mussel Pt Abundant between the 1.0 and -1 5 foot tide levels

Gracilaria robusta Setch At 15–25 feet near Pt Aulon. Isolated plants found between the -0 5 and -1 5 foot tide levels

Ahnfeltia gigartinoides J. A Ag. At 12–15 feet near Pt Aulon Not known from the intertidal zone.

Stenogramma californica Harv At 30–35 feet near municipal wharf, Monterey, at 20–25 feet near Pt Aulon Relatively scarce between the 0.5 and -1 5 foot tide levels.

Gigartina Boryi Setch. and Gardn At 12–15 feet near Pt Aulon Common between the 1 0 and –1.5 foot tide levels.

Gigartina corymbifera (Ktz) J G Ag At 20–25 feet near Mussel Pt and at Stillwater Cove Common between the 0 0 and –1 5 foot tide levels

Gigartina Harveyana (Ktz) Setch and Gardn At 25 feet near Pt Aulon. Common between the 1 0 and –1 5 foot tide levels

RHODYMENIALES

Rhodymenia californica Kylin At 20–25 feet near Pt Aulon and at Stillwater Cove Common between the 0 0 and –1 5 foot tide levels

Rhodymenia pacifica Kylin At 60–75 feet near Mussel Pt , at 15–20 feet, Stillwater Cove Common between the 0 0 and –1 5 foot tide levels

Gastroclonium Coulteri (Harv) Kylin. At 20–25 feet near Mussel Pt ; at 15–20 feet, Stillwater Cove Abundant between the 2 0 and –1 5 foot tide levels

Coeloseira compressa Hollenb At 20–30 feet near Pt Aulon Not known from the intertidal zone

CERAMIALES

Antithamnion defectum Kylin At 30–35 feet near Pt Pinos Not known from the intertidal zone

Antithamnion dendroideum G M Smith At 30–35 feet near municipal wharf, Monterey Not known from the intertidal zone

Antithamnion glanduliferum Kylin At 30–35 feet near municipal wharf, Monterey Rare between the 0 0 and –1 5 foot tide levels

Platythamnion heteromorphum J G Ag At 30–35 feet near municipal wharf, Monterey Not known from the intertidal zone

Platythamnion villosum Kylin At 30–35 feet near municipal wharf, Monterey, at 25–30 feet near Pt Aulon Rare between the 0 0 and –1 5 foot tide levels

Platythamnion pectinatum Kylin At 30–35 feet near municipal wharf, Monterey Rare between the 0 0 and –1 5 foot tide levels

Pleonosporium dasyoides (J G Ag) DeToni. At 35–50 feet near Pt Aulon, at 15–20 feet, Stillwater Cove Scarce between the 0 0 and –1 5 foot tide levels

Pleonosporium vancouverianum J G Ag At 30–35 feet near municipal wharf, Monterey Not known from the intertidal zone

Spermothamnion Snyderae Farl At 30–35 feet near municipal wharf, Monterey; at 35–40 feet near Mussel Pt , at 30–35 feet near Pt Pinos, at 20–25 feet, Stillwater Cove Common between the 0 5 and –1 5 foot tide levels

Griffithsia pacifica Kylin At 25–30 feet near Pt Aulon, at 30–35 feet near Pt Pinos; at 20–25 feet near Pescadero Rock Scarce between the 0 5 and –1 5 foot tide levels

Microcladia Coulteri Harv At 20–25 feet near Mussel Pt and at Stillwater Cove. Abundant between the 1.0 and –1 5 foot tide levels

Branchioglossum Woodii (J. G Ag) Kylin At 30–35 feet near municipal wharf, Monterey, and near Pt Pinos Very rare between the –0 5 and –1 5 foot tide levels.

Polyneura latissima (Harv.) Kylin At 30–35 feet near municipal wharf, Monterey, and near Mussel Pt , at 12–15 feet near Pt Aulon Common between the 0 0 and –1 5 foot tide levels

Phycodrys Setchellii Skottsb At 30–35 feet near municipal wharf, Monterey, at 20–30 feet, Stillwater Cove Very rare between the 0 0 and –1 5 foot tide levels

Nienburgia Andersoniana (J G Ag) Kylin At 20–25 feet near Pt Aulon and at Stillwater Cove Very scarce between the 0 0 and –1 5 foot tide levels,

Myriogramme spectabilis (Eaton) Kylin At 20 feet near Mussel Pt ; at 70–90 feet near Pt Aulon Not known from the intertidal zone

Cryptopleura violacea (J G Ag) Kylin At 30–35 feet near municipal wharf, Monterey, at 20–25 feet near Pt Aulon, at 15–20 feet, Stillwater Cove Abundant between the 0 5 and –1 5 foot tide levels

Botryoglossum Farlowianum (J G Ag) DeToni At 30–35 feet near municipal wharf, Monterey, at 20–25 feet near Pt Aulon, at 15–20 feet, Stillwater Cove Abundant between the 0 0 and –1 5 foot tide levels

Dasyopsis densa G M Smith At 30–35 feet near municipal wharf, Monterey Not known from the intertidal zone

Polysiphonia californica Harv At 20–25 feet near Pescadero Rock Common between the 1 0 and –1 5 foot tide levels

Polysiphonia flaccidissima var *Smithii* Hollenb At 35–40 feet between Mussel Pt and Pt Aulon Not known from the intertidal zone

Pterosiphonia dendroidea (Mont) Falkenb At 20–25 feet near Pt Aulon and near Pescadero Rock Abundant between the 0 0 and –1 5 foot tide levels

Pterosiphonia Baileyi (Harv) Falkenb At 20–25 feet near Mussel Pt and near Pt Aulon Common between the 0 5 and –1 5 foot tide levels

Herposiphonia rigida Gardn At 30–35 feet near municipal wharf, Monterey Rare between the 0 0 and –1 0 foot tide levels

Herposiphonia pygmaea Hollenb mss At 20–25 feet near Pt Aulon, at 35–40 feet near Pt Pinos Not found in the intertidal zone

Laurencia spectabilis Post and Rupr At 15–20 feet, Stillwater Cove Abundant between the 1 0 and –1 5 foot tide levels

Laurencia Gardneri Hollenb At 30 feet near Mussel Pt , at 35–40 feet near Pt Aulon, at 30–35 feet near Pt Pinos, at 20–25 feet near Pescadero Rock Isolated plants found between the 0 0 and –1 5 foot tide levels

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ALICE EASTWOOD SEMI-CENTENNIAL PUBLICATIONS

No 5

THE GANDER OAK, A NEW HYBRID OAK FROM SAN DIEGO COUNTY, CALIFORNIA

BY
CARL B WOLF
Botanist, Rancho Santa Ana Botanic Garden

In the nearly a century and a half since Neé published the first two species of *Quercus* from California (*Quercus agrifolia* and *lobata*) the list has grown so that now at least eighteen generally recognized species are believed to constitute the oak flora of the state In addition to these species there are several rare forms which have evoked considerable interest One of the first of these to be brought to the attention of botanists was the Oracle Oak (× *Quercus morehus* Kellogg, Proc Calif Acad Nat Sci , 2 36, 1863), long suspected of being a hybrid between *Quercus Kelloggii* Newb and *Quercus Wislizenii* A DC , but only recently so demonstrated by cultural experiments at Rancho Santa Ana Botanic Garden (Rancho Santa Ana Bot Gard , Occas Papers, 1 47–52 1938)

In 1935 Mr Frank F Gander, botanist of the Museum of Natural History at San Diego, California, discovered another peculiar oak somewhat similar to the Oracle Oak This tree grew along the road between Santa Ysabel and Lake Henshaw Shortly thereafter Mr Gander informed us of his find and we visited the area, located the original tree and several others like it In the fall of 1939 we obtained acorns of this new oak for propagation at Rancho Santa Ana Botanic Garden The results of our studies in the field and in the Garden are embodied in the present paper It is a pleasure to publish this oak as new in honor of Mr Gander in the Proceedings of the California Academy of Sciences, since one of the parents of this hybrid is *Quercus Kelloggii*, a species honoring Dr Albert Kellogg, one of the founders of the Academy, and also a most devoted student of our oaks. His beautiful drawings of oaks were published in 1889 (Illustrations of West American Oaks, with the text by Dr E L Greene) It has also seemed appropriate that this article should appear in the volume dedicated to Miss Alice Eastwood because she has long been interested in oaks and published one of the last of the generally recognized entities for California (*Quercus Alvordiana* Eastw., Handbook of the Trees of California, p 48, pl 27, fig 4, 1905) She is a charter member of the Rancho Santa Ana Botanic Garden Advisory Board where her enthusiasm for the Garden's experimental work has been a constant stimulus for us to go forward with the numerous, painstaking, slow and often disappointing cultural projects, many of which seem to yield so little in proportion to the time and energy required for their completion

× **Quercus Ganderi** C B Wolf, hybr nov

(*Quercus Kelloggii* Newb × *Quercus agrifolia* var *oxyadenia* [Torr] J T Howell)

Tree 10–16 m high, 6–10 m spread, trunk up to 1 m in diam, the bark dark brown or gray, comparatively smooth and essentially like that of *Quercus Kelloggii* In aspect the tree is erect, usually is taller than broad and more nearly resembles *Q Kelloggii* than it does *Q agrifolia* var *oxyadenia* Leaves nearly evergreen, turning yellow in January and shedding shortly before the new leaves appear Branchlets densely puberulent, but in the second year becoming nearly glabrous Petioles 1–2 5 cm long, blades coriaceous, slightly cupped, glossy green above, but microscopically stellate-pubescent, especially along the midribs and veins, gray-green beneath and at first heavily stellate-pubescent, but in age becoming much less so, 5–10 cm long, 3–6 cm wide, shallowly and irregularly lobed with 3 or 4 main lobes on each side, these in turn irregularly margined and bearing 1–4 bristle-tipped teeth Acorns solitary or 2–3 in a cluster, produced abundantly some years, and apparently maturing the first season, styles 3, about 2–3 mm long, cup 12–18 mm high, 15–25 mm broad, the inner surface hairy at base, nearly glabrous at margins, scales thin, light tan with a darker border and mostly with ciliated margins, well imbricated in 6–8 rows, nut with lower one-third covered by the cup, oblong, 25–35 mm long, lightly pubescent to nearly glabrous without, densely pubescent within, rich light brown at maturity (The acorns are scarcely distinguishable from those of *Q Kelloggii*, except that the nut is somewhat slenderer pointed) Staminate aments slender, pubescent, borne in clusters of several, each ament 4–6 cm long, bearing about 15–20 flowers, each with 6–8 stamens

Arbor erecta, circiter 10–16 m altitudine, ramulis junioribus tomentellis, foliis habitus *Quercus Kelloggii*, 5–10 cm longis, 3–6 cm latis, pagina superiore sub glabra, inferiore stellata tomentosa, cupulis 12–18 mm altitudine, squamis planus; glandibus oblongis, 25–35 mm longis

Habitat Lower borders of the Arid Transition and the upper borders of the Upper Sonoran Life Zones at elevations of 3000 to 3200 feet, in association with *Quercus Kelloggii, agrifolia* var *oxyadenia* and *Engelmannii,* growing on hillsides and near occasional streams in granitic type soils

Range. Known only from the mountains of San Diego County, California All of the known trees are located in a rather restricted area extending from the Volcan Indian School, located north of Santa Ysabel, to a mile or two west of Lake Henshaw Dam and to the vicinity of Mesa Grande

Type Locality San Diego County, California, about 300 yards north of the entrance to the Volcan Indian School on California State Highway No 79 between Santa Ysabel and Lake Henshaw, at 3100 feet elevation, in decomposed granite soil, near an occasional stream just west of the highway Type Specimen *Carl B Wolf and Percy C Everett, Herb No 9543 (Prop No 3555),* collected October 20, 1939, the tree being 16 m high, 10 m spread, its trunk branching into three main forks near the ground, two of these being about 46 cm in diam , and the third about 20 cm in diam The Type Specimen is deposited in Rancho Santa Ana Botanic Garden Herbarium, sheet no 23585 Isotypes widely distributed as indicated below

Localities and Specimens Examined All of the localities mentioned below are in San Diego County, California

1) Near the entrance to the Volcan Indian School between Santa Ysabel and Lake Henshaw, at 3100 feet elevation *Frank F Gander,* Nov 14, 1935, and May 6, 1937, *C B Wolf and P C Everett, Herb No 9483,* January 10, 1939, *P C Everett, Herb No 9529,* July 28, 1939, *C B Wolf and P C Everett, Herb No 9543 (Prop No 3555),* Oct 20, 1939, Type Collection (All of the above specimens were made from the same tree)

2) Between Santa Ysabel and Lake Henshaw, on the Morelli Ranch, located about 2 miles south of the junction of the road to Warner's Hot Springs and Henshaw Dam, 3000 feet elevation *C B Wolf, Herb No 9487,* January 24, 1939, from a tree 10 m high, 10 m spread, and a trunk 60 cm in diam and from the same tree, *C B Wolf and P C Everett, Herb No 9512 (Prop No 3554),* October 20, 1939

3) Mesa Grande, *M V Hood,* Nov 24, 1940

4) One and eight-tenths miles from Mesa Grande on the road to Lake Henshaw, at 3200 feet elevation *C B Wolf, Herb No 9488,* January 24, 1939 from a tree 11–12 m high, 6–7 m spread, and a trunk 35 cm in diam , *C B Wolf, Herb No 9489,* January 24, 1939, from a tree 12–13 m high, 11–12 m spread, and a trunk nearly 1 m in diam

5) Between Mesa Grande and Lake Henshaw (north of the above locality) Several trees were noted on January 24, 1939, on the slopes away from the road, but for lack of time no collections were made

6) On the hills to the south and west of Lake Henshaw Dam The trees noted in this area on January 24, 1939, appeared to be the northwest limit of distribution for the Gander Oak in this region, but for lack of time no specimens were collected

In its native habitat the individual trees of the Gander Oak are difficult to detect during most of the year except upon close examination, for they are mixed with the Kellogg Oak, which they closely resemble. However, in the late fall or early winter they can readily be spotted on the hillsides At those times the leaves of the Kellogg Oak have been shed, while those of the Gander Oak are beginning to turn yellow In January of 1939 we were able to locate between 20 and 30 Gander Oaks in the vicinity of Lake Henshaw and Mesa Grande merely by driving slowly along the roads that traverse the areas Exploration of the adjacent hillsides not visible from these roads would likely result in increasing this figure considerably It is also probable that the Gander Oak occurs elsewhere in San Diego County, but thus far no additional localities have been brought to our attention All of the trees of the Gander Oak which we have seen in the wild appear to be first-generation crosses between the two parents, despite the fact that fertile acorns appear to be produced somewhat regularly However, this lack of second-generation offspring in the wild is in keeping with the behavior of many other wild hybrids

Wild trees of × *Quercus Ganderi* can be distinguished from *Quercus Kelloggii* by the less deeply lobed and slightly cupped leaves with considerable pubescence beneath, and by the longer persistence of the foliage Separation of × *Quercus Ganderi* from × *Quercus morehus* is also relatively easy, although the leaves of the two are very similar in size and outline The latter species has nearly plane leaves whose under surfaces are practically glabrous Furthermore, × *Quercus morehus* requires two seasons to mature its acorns, whereas, × *Quercus Ganderi* appears to mature its acorns in a single season (as does *Quercus agrifolia* var *oxyadenia*)

In October, 1941, Mr John M Tucker of the Department of Botany of the University of California, Berkeley, California, forwarded us an oak specimen (*Tucker No 418*) collected on the University of California Hastings Wild Life Reserve in the Santa Lucia Mountains of Monterey County. This specimen appears to be a hybrid between *Quercus Kelloggii* and *Quercus agrifolia*, but we have not been able to visit the area and see the tree growing in the wild, nor has it been possible to obtain acorns for propagation Tucker's specimen closely resembles × *Quercus Ganderi*, but is essentially glabrous. The status of this oak should be determined by additional field studies and by experimental methods If it should be demonstrated that it is a hybrid, as suggested above, it could hardly be included in the present concept of ×*Quercus Ganderi* unless that concept be enlarged and *Quercus agrifolia* var *oxyadenia* be reduced to synonomy under *Quercus agrifolia*

CULTURAL STUDIES

Because of the practical difficulties involved in making experimental crosses in the field we have not attempted to produce × *Quercus Ganderi* by hybridizing *Quercus Kelloggii* and *Quercus agrifolia* var *oxyadenia* We have, however, been able to observe the behavior of seedlings of × *Quercus Ganderi* and feel that they have yielded sufficient data to justify our conclusion that the tree is a hybrid between *Quercus Kelloggii* and *Quercus agrifolia* var *oxyadenia*.

In October, 1939, Mr Everett and I hand-picked over 400 acorns from the Type Tree of × *Quercus Ganderi* (*Herb No 9543, Prop No 3555*), and 11 acorns from a second tree in the same region (*Herb No. 9542, Prop. No 3554*). These acorns were subsequently planted in our lathhouse, where by April, 1940, there were 311 seedlings of the former and 8 of the latter In contrast to the seedlings of × *Quercus morehus*, grown previously, these were remarkably vigorous and attained average heights of over 30 cm the first season

Plantings of 189 seedlings (random selections) of the Gander Oak (*Prop No 3555*) were made in the Garden on March 10, 1941 Only 61 of these survived to October, 1942 This unusually high loss can be accounted for in part because at that time the Botanic Garden Nursery was moved and it was necessary to dig the seedlings and hold them for considerable time before planting The remainder of the seedlings of this same lot were lined out in nursery rows where over 50 are still alive In the same nursery rows are 5 seedlings of *Prop No 3554* These seedlings in the Garden and in the nursery rows now show the usual intergradation of characters displayed when seeds of a hybrid are propagated Those seedlings closely resembling *Quercus Kelloggii* are now few in number, for, under our conditions, that species has always been difficult to grow The rest of the seedlings now alive represent several typical *Quercus agrifolia* var *oxyadenia*, a large number of forms very much like the original × *Quercus Ganderi*, and many of varying characteristics Some have the leaf shapes nearly like *Quercus Kelloggii*, but are exceptionally pubescent Others are like *Quercus agrifolia* var *oxyadenia*, but are glabrous Still others have numerous intermediate leaf characters and are even more unlike either of the parent species of the original cross It will be many years before acorns are produced by these seedlings, but they will likely show an almost continuous series of variations between the slender form produced by the one parent and the thick form by the other It is also probable that some of these seedlings will require two seasons to mature acorns while others should do so in a single season

× *Quercus Ganderi* may eventually prove of some merit for horticulture, for it has many of the fine features of *Quercus Kelloggii*, plus semi-evergreen foliage, a vigorous growth rate and hardiness at low elevations Acorns gathered from some of the wild trees could be grown in the nursery for two or three years, so that selections of outstanding horticultural types could be made before making permanent plantings

The accompanying drawings on Plates 18 and 19 of *Quercus Kelloggii*, *agrifolia* var *oxyadenia*, *Ganderi* and the nursery seedlings grown from the latter were prepared from tracings (except the drawings of the acorns) It is hoped that they will convey to the reader not only the characteristics of the parental species and the original hybrid, but also the great variation exhibited by the seedlings

DISTRIBUTION OF HERBARIUM SPECIMENS

Specimens referred to in the text and in the figures are all on deposit in Rancho Santa Ana Botanic Garden Herbarium with the exception of the two specimens by F F Gander and the one by M V Hood, which are in the San Diego Museum of Natural History Herbarium Duplicates of our collections of × *Quercus Ganderi* have been distributed as follows:

California Academy of Sciences, San Francisco, California *Nos 9483, 9487, 9488, 9489, 9529, 9543,*

Dudley Herbarium, Stanford University, California *Nos 9483, 9487, 9488, 9489, 9529, 9542, 9543,*

Field Museum of Natural History, Chicago, Illinois *No 9543,*

Los Angeles Museum, Los Angeles, California *No 9543,*

Missouri Botanical Garden, St Louis, Missouri *No 9543,*

New York Botanical Garden, New York City, N Y *No 9543,*

Philadelphia Academy of Natural Sciences, Philadelphia, Penna *No 9543,*

Pomona College, Claremont, California *No 9543,*

San Diego Museum of Natural History, San Diego, California *Nos 9483, 9487, 9488, 9489, 9529, 9543,*

United States National Herbarium, Washington, D C *Nos 9483, 9488, 9543,*

University of Arizona, Tucson, Arizona *No 9543,*

University of California, Berkeley, California *Nos. 9483, 9487, 9488, 9489, 9529, 9543,*

University of California, Los Angeles, California *Nos 9483, 9543,*

University of Colorado, Boulder, Colorado *No 9543,*

University of Montana, Missoula, Montana *No 9543,*

University of Washington, Seattle, Washington *No 9543*

EXPLANATION OF PLATES

PLATE 18

Figs 1–24 Leaves of seedlings of × *Quercus Ganderi* C B Wolf, collected from Botanic Garden plantings and nursery rows, January 13, 1943, *Prop No 3555* (grown from acorns taken from Type Tree).

Figs 1–7 From seedlings most nearly like *Quercus Kelloggii*.

Figs 8–15 From seedlings most nearly like *Quercus agrifolia* var. *oxyadenia*.

Figs 16–24 From seedlings most nearly like × *Quercus Ganderi* and intermediate forms

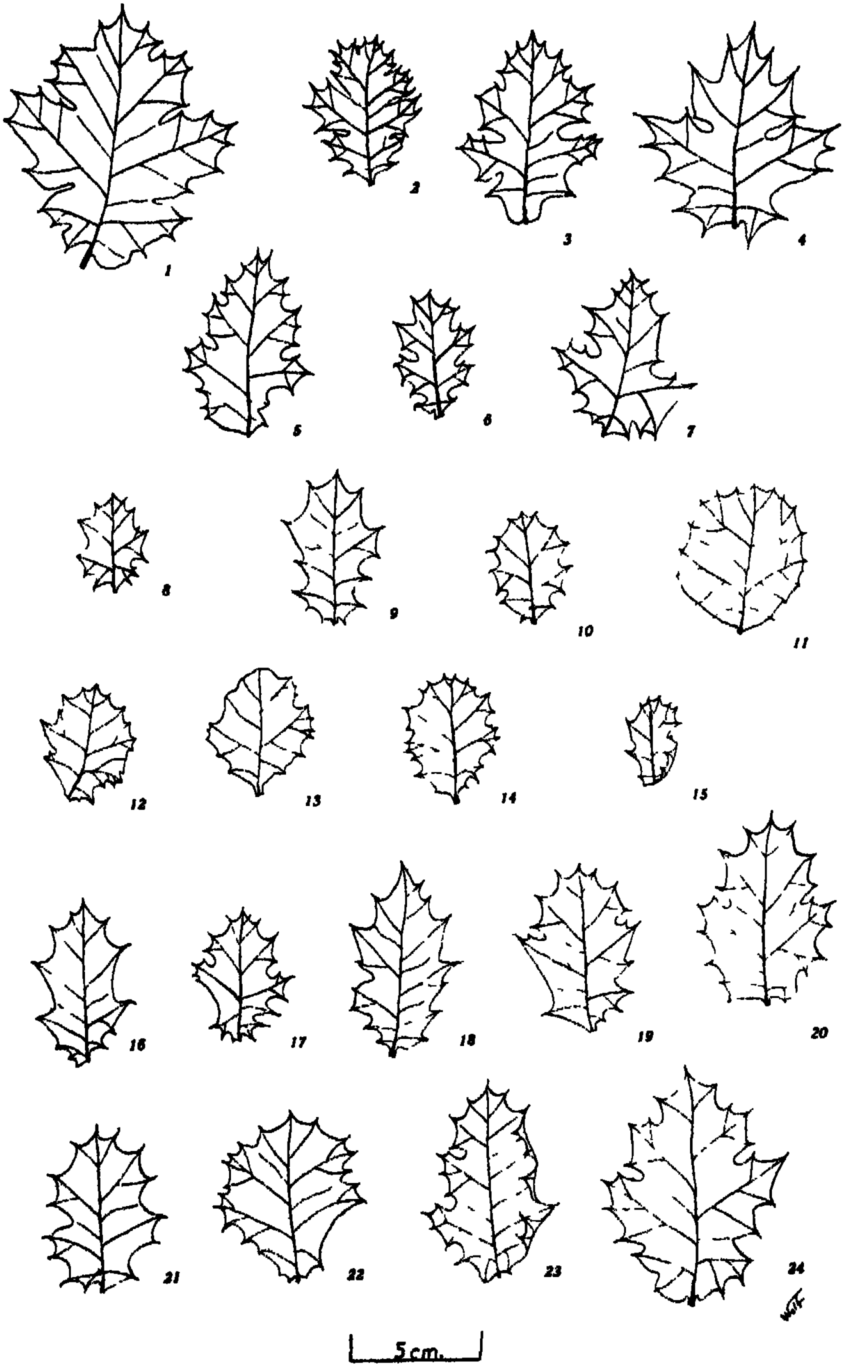

Wolf
5 cm.

PLATE 19

Figs 1–10 *Quercus Kelloggii* Newb

Figs 11–18 *Quercus agrifolia* var *oxyadenia* (Torr) J T Howell

Figs 19–30 × *Quercus Ganderi* C B Wolf

Fig 1 *C B Wolf, Herb No 2488* (wild)

Fig 2 *J T Howell, Herb No. 683* (wild)

Figs 3 and 4 *C B Wolf, Herb No 3992* (wild)

Fig 5 *C B Wolf and B D Stark, Herb No 5482* (wild).

Fig 6 *P C Everett, Herb No 6081* (nursery seedlings of *Prop No 1951*)

Fig 7 *C B Wolf, Herb No 5572* (nursery seedlings of *Prop No 1951*)

Fig 8 *P C Everett, Herb No 6078* (nursery seedlings of *Prop No 1952*)

Fig 9 *B D Stark, Herb No 798* (acorn, wild)

Fig 10 *C B Wolf, Herb No 2488* (acorn, wild)

Fig 11 *J T Howell, Herb No 600* (wild)

Fig 12 *B D Stark, Herb No 5552* (wild)

Fig 13 *I L Wiggins and J W Gillespie, No 4053* (wild)

Fig 14 *B D Stark, Herb No 5552* (wild)

Fig 15 *I L Wiggins and J W Gillespie, No 4053* (acorn, wild)

Fig 16 *B D Stark, Herb No 5552* (acorn, wild)

Figs 17 and 18 *P C Everett, Herb No 6074* (nursery seedlings of *Prop No 2026*)

Fig 19 *C B Wolf Herb No 9489* (wild, as are also nos 20–30)

Fig 20 *C B Wolf and P C Everett, Herb No 9483*

Fig 21 *C B Wolf and P C Everett, Herb No 9543* (Type)

Figs 22 and 23 *C B Wolf and P C Everett, Herb No 9543* (acorns from the Type)

Fig 24 *P C Everett, Herb No 9529* (young acorn)

Fig 25 *C B Wolf, Herb No 9488*

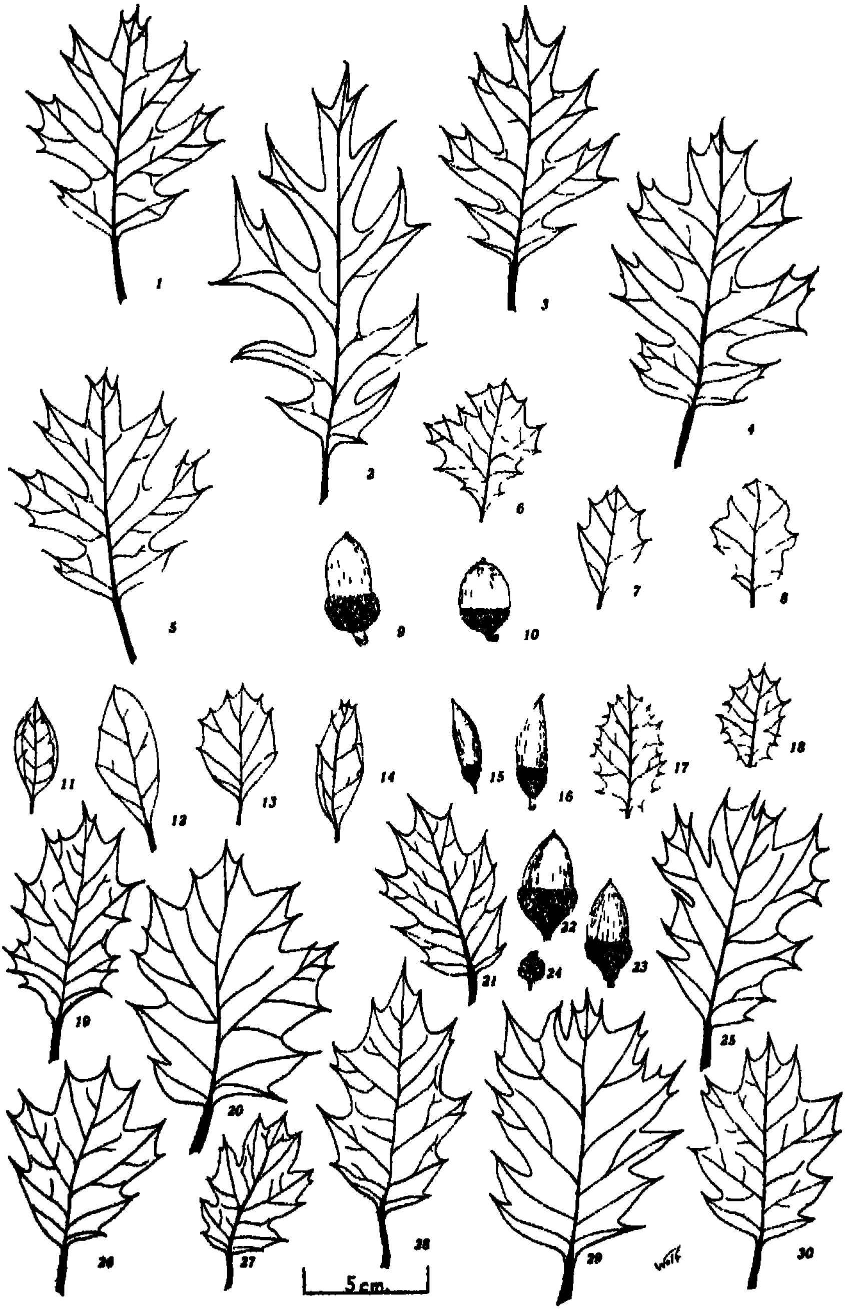
Fig 26 *C B Wolf, Herb No 9489*

Fig 27 *C B Wolf and P C Everett, Herb No 9542*

Fig 28 *C B Wolf and P C Everett, Herb No 9543* (Type)

Fig 29 *C B Wolf and P C Everett, Herb No 9487.*

Fig 30 *C B Wolf and P C Everett, Herb No 9542*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5 cm.
Wolf

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ALICE EASTWOOD SEMI-CENTENNIAL PUBLICATIONS

No. 6

THE GENUS DRYMARIA IN, AND ADJACENT TO, THE SONORAN DESERT

BY
IRA L. WIGGINS
Professor of Biology (Botany), Stanford University

The taxonomist frequently finds that it is necessary to study not only those represenstatives of a genus that occur within a circumscribed area in which he is interested, but numerous other species from contiguous regions as well This necessity became apparent at once when I attempted to construct a key to the species of *Drymaria* known to occur within the limits of the Sonoran Desert, for the relationships of several of the desert species were obviously with forms growing in the mountains nearby, or in the drier parts of New Mexico, Texas, and northern Mexico As these close relatives were studied, still others had to be taken into account until eighteen entities entered into the problem Of this number, only four or five actually grow within the desert, but it seemed desirable to present the total results of the study rather than to restrict the paper to a treatment of those species which occur regularly in the desert.

Willdenow recognized four species, three of them new, when he set up the genus *Drymaria* in 1819 (in R. and S. Syst Veg 5 406, 1819), and based the new genus on *Holosteum cordatum* Linn. Five years later DeCandolle (Prodr. 1·395, 1924) listed five species, the fifth having been described by Humboldt, Bonpland, and Kunth in 1823 (Nov. Gen et Sp 6 17–21, *pl 515–516*, 1823). Since that time there has been a steady increase in the number of species recognized in the genus. At present, one hundred nine specific and varietal names have been applied in *Drymaria*. It is probable that a thorough investigation of the genus would require reduction of certain combinations and the description of other forms not as yet recognized

Most of the species and varieties of *Drymaria* occur in Mexico and the western part of South America Sixty-four, exclusive of the new entities proposed here, have been described from North America, about thirty from South America, several from the West Indies and Central America, one species is nearly cosmopolitan in the tropics, and one occurs in Australia Over fifty species have been recorded from Mexico

The genus includes both annual and perennial herbs, the latter sometimes slightly suffrutescent at the base Most species are clearly annual or perennial, with little or no tendency for the annuals to persist beyond a single growing season But occasionally a plant of an annual species may, under particularly favorable conditions, become a biennial or short-lived perennial

The species vary in habit from prostrate, through procumbent and ascending, to strictly erect plants The stems may be simple, unbranched, or profusely branched from either the base or in the upper part of the plant The stems and branches are slender, often nearly filiform in such species as *D tenella, D debilis,* and *D. carinata* The internodes may be rather short, as in *D crassifolia,* with the leaves exceeding the internodes and forming dense mats, or they may be greatly elongated and much surpassing the leaves, as in the closely related *D holosteoides* The herbage is pubescent in some species, glabrous or glabrate in others The pubescence may be glandular or non-glandular in different species

The leaves are useful in separating the genus into two main groups, one of which possesses leaves that are ovate, cordate, or broadly elliptic and from half as wide as long to distinctly broader than long The other group has leaves that are linear, filiform, or narrowly oblong or subulate These leaves show little tendency toward an elliptic outline and are always several times as long as broad A few species have fleshy or leathery leaves, but most of them have thin, herbaceous leaves of delicate texture

The arrangement of the flowers in the inflorescence is racemose or cymose The former arrangement is found in *D holosteoides, C crassifolia,* and *D pachyphylla* In these species the flowers appear to be in dense clusters in the axils of most leaves and at or near the apices of the branches Examination of this arrangement reveals that the flowers are borne in a short raceme, each flower subtended by a small, scarious bract The minute bracts nearly conceal the rachis Such racemes are axillary to the larger leaves of the fascicles formed at each node In other species studied the inflorescence is cymose A schematic representation of this type of inflorescence as exhibited by most of the annual species of *Drymaria* is shown in Pl 20, fig 1, and a diagram of the inflorescence of *D sperguloides* is shown in fig 2 In the latter figure, the small, solidly inked circles represent abortive flowers

Floral characters useful in differentiating species of *Drymaria* include the shape, length, comparative length and width, venation, and texture of the sepals, the shape, depth of the lobing, length as compared with the length of other floral structures, and the presence or absence of appendages between the main lobes of the petals, and the comparative length of claw and blade of the petals Flowers of comparable age must be selected in making these comparisons, however, for the petals are persistent and the mature capsules are usually much longer than the ovary at anthesis

The aestivation of the sepals is, in all cases examined, cochlear, a modification of the imbricate pattern In this type of sepal arrangement one sepal is wholly outside the others, one has both margins overlapped by adjacent sepals, and of the other three each has one margin overlapped by an adjacent sepal and the other margin overlapping that of its neighbor The outermost, exposed sepal is on the abaxial side of the calyx, while the one with both margins covered is on or near the adaxial side The margins that are covered by the edges of adjacent sepals are almost always more broadly scarious-winged than the exposed margins (Pl 20, fig 3) This does not hold in the case of *D carinata* and its variety, for in these plants the thicker, herbaceous part of the sepals is reduced to a narrow midrib and the sepals are nearly or quite symmetrical

All species studied have stamens that are slightly dilated at the base to form a shallow, connate cup

It is doubtful that there is any value in trying to differentiate between species with "stipitate" and "sessile" ovaries, for all species examined had the ovaries elevated to some degree on a slender, short stipe Though short, this stipe was distinctly demonstrable in every case

The seeds are so small that definitive measurements are difficult to make Differences in the depth of the notch adjacent to the hilum, the sculpturing of the surface, the over-all pattern of the surface markings, and sometimes the color of the seeds can be used to advantage The seeds of *D viscosa* are striking in that they are smooth and pale cream or pale buff instead of tessellated, muriculate, or tuberculate and dark colored as the seeds of most other species are

During the course of this study the material of *Drymaria* at the California Academy of Sciences, in the herbarium of the University of California, and in the Dudley Herbarium at Stanford University has been available constantly The types of a number of species were studied, notes taken, and photographs of them made during a visit to the herbarium of the Royal Botanic Garden at Kew, Surrey, and to the Gray Herbarium of Harvard University in 1937 These notes and photographs were valuable aids in determining specific limits The type specimens of Brandegee's species, deposited in the herbarium of the University of California, and an isotype of *D depressa* Greene, in the herbarium of the California Academy of Sciences, clarified the status of several poorly known species My sincere thanks are due, and gladly given, to Miss Alice Eastwood for permitting me to borrow material from the herbarium of the California Academy of Sciences Appreciation is hereby expressed, also, to Dr Herbert L Mason, of the University of California, to Mr A D Cotton, Keeper of the Herbarium of the Royal Botanic Garden, Kew, England, and to Dr M. L Fernald, of the Gray Herbarium at Harvard

University, for the privilege of studying material and types deposited in the herbaria under their supervision

In citing specimens, the herbaria in which the specimens are deposited are indicated by the following abbreviations

California Academy of Sciences . . .	CA
Dudley Herbarium, Stanford University .	D
Gray Herbarium, Harvard University	G
Royal Botanic Garden, Kew, England .	K
University of California at Berkeley	UC

TAXONOMIC TREATMENT

Drymaria Willd in R and S

Syst Veg 5 406, 1819

Annual or perennial plants with slender, prostrate, decumbent, ascending, erect or scrambling stems Branches simple or profusely branched, sparsely to densely foliate Leaves linear, subulate, elliptic, ovate, or cordate, thin and herbaceous or thick and fleshy or leathery, glabrous or pubescent, glandular or eglandular, stipules usually present, subulate or linear, persistent or fugacious Flowers small, in cymes or racemes, sessile or pedicellate, sepals 5, 1–3-nerved, similar or slightly dissimilar, the middle portion herbaceous and often puberulent or grandular, one or both of the margins scarious-winged, petals (in ours) deeply cleft, in some species bearing additional narrow appendages near base of the cleft, stamens 5, the filaments slightly dilated and connate at the base; anthers ovate, much shorter than the filaments Style slender, from much shorter than, to about equal to, the ovary, stigma 3-lobed or 3-cleft, the lobes shorter or longer than the style Capsule ovoid to subglobose, longitudinally dehiscent, mostly 3-valved, 1-celled Seeds obovoid to obovoid-reniform, variously sculptured, most dark brown, dull or slightly shining.

Type species —*Holosteum cordatum* Linn

KEY TO THE SPECIES

- **Leaves about as broad as, or broader than long**
  - **Flowers in short, crowded, umbel-like racemes, leaves leathery or fleshy, often glaucous, plants mostly prostrate or decumbent**
    - **Stamens equaling or surpassing the ovary at anthesis, style one fourth as long as, or equaling, the ovary, petals with 4–6 appendages near base of inner margins of main lobes**
      - **Herbage somewhat puberulent, scarcely glaucous, petals 3–3 5 mm long, about equaling the sepals, style 1 4–1 6 mm long, internodes exceeding the leaves 1 *D holosteoides***
      - **Herbage glabrous, conspicuously glaucous, petals 2–2 2 mm long, shorter than the sepals, style 0 6–0 8 mm long, internodes mostly shorter than the leaves 2 *D crassifolia***
    - **Stamens about half as long as the ovary at anthesis, style less than one fifth as long as the ovary; petals with only one appendage at base of each main lobe . . 3 *D pachyphylla***

Flowers in cymes, leaves thin, not fleshy nor leathery, rarely glaucous, plants mainly erect or ascending

Sepals strongly carinate, the herbaceous mid portion narrowly linear

Claws of petals half as long as, and gradually widening to, the blade, petals slightly exceeding the sepals, plant annual . . 4 *D. carinata.*

Claws of petals very short, less than one sixth as long as, and flaring abruptly to, the limb, petals often twice as long as the sepals, plants perennial 4a *D. carinata* var. *perennis*

Sepals not carinate, subequal, the herbaceous mid portion elliptic

Petals surpassing the sepals, sepals not strongly ribbed

Sepals oblong elliptic or narrowly oblanceolate, obtuse at the apex, petals 5–6.5 mm. long, pubescence of short hairs 0.4 mm. long or less

Plants perennial, leaves shallowly cordate, sepals glabrous or sparingly hairy near base 5 *D. polystachya.*

Plants annual, leaves truncate or broadly cuneate at the base, sepals copiously glandular puberulent on lower two thirds 5a *D. polystachya* var. *diffusa.*

Sepals broadly ovate, acute at the apex, petals 3.8–4.5 mm. long, pubescence of crinkled, spreading hairs to 1 mm. long 6 *D. debilis*

Petals shorter than the sepals, sepals strongly 3 ribbed 7 *D. Fendleri*

Leaves linear or narrowly oblong, several times as long as broad

Herbage heavily viscid puberulent throughout, seeds smooth, not tessellate nor muriculate 8 *D. viscosa*

Herbage viscid-puberulent only on pedicels and sepals, or glabrous, seeds tessellate, muriculate, or otherwise roughened

Petals fimbriate appendaged.

Herbaceous part of sepals obtuse, glabrous, stigmas subsessile, petals with 1 lobe at base of each main lobe, leaves pseudo verticillate 9 *D. sperguloides*

Herbaceous part of sepals acute, glandular puberulent, stigmas not subsessile, petals with 2–4 appendages at base of each main lobe, leaves not pseudo-verticillate

Petals 6 mm. long, much exceeding the sepals, appendages long, slender, nearly equaling the main lobes, leaves narrowly elliptic 10 *D. arenarioides*

Petals 4 mm. long, barely exceeding the sepals, appendages oblong, half to two thirds as long as the main lobes, leaves narrowly linear 11 *D. peninsularis*

Petals merely bifid, without appendages along inner margins of main lobes

Petals slightly exceeding the sepals, plants puberulent.

Herbaceous part of sepals obtuse, leaves mostly 5 mm. long or less, claws of petals narrow, naked 12 *D. Johnstonii*

Herbaceous part of sepals acute, leaves mostly over 10 mm. long, claws of petals broadly winged, as wide as the limb 13 *D. effusa.*

Petals shorter than the sepals, plants glabrous, or base of sepals and upper parts of internodes sparsely puberulent.

Stems erect, branching above; leaves narrowly linear, 1 mm. wide or less, seeds minutely but sharply muriculate

Sepals acute, herbage glabrous .14 *D. tenella*

Sepals acuminate, upper parts of internodes and bases of sepals puberulent 14a *D. tenella* var. *nodosa*

Stems decumbent or spreading, branched from the base, leaves oblong, to 3 mm. wide, seeds tessellate with low, rounded bosses. 15 *D. depressa*

1. **Drymaria holosteoides** Benth Bot Voy Sulph 16, 1844

(Plate 20, figs 4–12)

Drymaria Veatchii Curran, Proc Calif Acad. Sci. (II), 1 227, 1888
Mollugophytum holosteoides M E Jones, Extract from Contr. West Bot 18 35, 1933

Annual, with slender, spreading, decumbent or prostrate stems 4–40 cm long, some of them often stolon-like and forming secondary rosettes at rooted nodes, internodes 2–10 cm long, mostly conspicuously exceeding the leaves, spreadingly puberulent and somewhat glandular, older stems glabrate, stipules lacking or represented by narrow scarious wing between bases of a leaf-pair, leaves mostly in fascicles of 4–6 at each node, blades spatulate-elliptic, 3–7 mm wide, 4–12 mm long, somewhat fleshy or leathery, faintly 3-nerved beneath, glabrous or sparsely puberulent near the base, lightly glaucous, on slender petioles 2–10 mm long, flowers in dense, short racemes in axils of most leaves, each flower subtended by a narrow, ovate, hyaline bract about 1 mm long, pedicels slender, 3–9 mm long, glandular-puberulent, sepals obovate, obtuse or rounded at the apex, 3–3 5 mm long, the middle portion herbaceous, glandular-puberulent at the base, glabrous and faintly glaucous above, the scarious margins conspicuous, petals persistent, about equaling the sepals, 2 8–3 2 mm long, white, bifid about half way to the base and bearing 2–4 narrow segments near the base of inner margin of each main lobe, the claw short, broad, somewhat erosulate, stamens about equaling the petals, nearly twice as long as the ovary, filaments slightly dilated at the base; ovary about 1 5 mm high, style equaling the ovary, capsule broadly ovoid, 1 5–2 mm high, seeds obovoid-reniform, 0 6–0 8 mm long, dark brown to black, dull, minutely rounded-tuberculate in longitudinal lines

Type locality.—"Cape San Lucas," Baja California, Mexico

Distribution:—Sandy areas from the vicinity of Calmalli to La Paz, and possibly to Cape San Lucas, Cedros Island, Magdalena Island, Tiburon Island, Mexico

Specimens examined —Magdalena Bay, *Hinds*, 1841, (K, type This is the only specimen of *D. holosteoides* in the Kew Herbarium collected on the Voyage of the "Sulphur," and in spite of the statement in Bentham's publication to the effect that the plant was obtained at "Cape San Lucas" the type locality is probably Magdalena Bay, on Magdalena Island) Madgalena Bay, *Brandegee*, March 1889, (UC), *Bryant*, 1888, (UC, type of *D Veatchii*), hills east of Calmalli, *Purpus 151*, (D, UC), rocky hillside 4 miles east of San Ignacio, *Wiggins 7898*, (D, UC); 2 miles west of San Ignacio, *Reed 6156*, (D), Coyote Bay, Concepción Bay, *Johnston 4178*, (CA), *Gentry 4059*, (D), Concepción Bay, *Shreve 7095*, (D), 5 miles south of head of Concepción Bay, *Wiggins 5456*, (CA, D, UC), Mulége, *Johnston 3690*, (CA), San Luis Gonzales Bay, *Johnston 3389*, (CA); San Francisco Island, *Johnston 2949*, (CA), dry washes between Medano and Venancio, *Wiggins 5531*, (D, UC), La Paz, *Johnston 3048*, (CA, UC), *Brandegee*, Feb. 2, 1890, (UC), Cedros Island, *Stewart 48–49*, (CA), Willard's Point, Tiburón Island, Sonora, *Johnston 4363*, (CA, D, UC)

A long-standing confusion concerning the identity of this species and the closely related *D crassifolia* was cleared up by Brandegee (Zoe 2· 66–70 1891).

The petals in *D. holosteoides* are more pronouncedly fimbriate at the base of the sinus than they are in *D crassifolia*, and the style is nearly or quite as long as the ovary in *holosteoides*, but only half as long in *D crassifolia* The densely matted habit of *crassifolia* is the most readily observed character for separating the two species

2 **Drymaria crassifolia** Benth Bot Voy Sulph 16, 1844

(Plate 20, figs 20–26)

Mollugophytum crassifolium M E. JONES, Extract from Contr West. Bot 18.35 1933

Prostrate, matted, glabrous and, glaucous perennial; stems profusely branched, 3–20 cm long, internodes 0 5–2 5 cm long, mostly obscured by the numerous, fasciculate leaves, stipules as in *D holosteoides,* petioles slender, 3–9 mm long, leaf-blades broadly ovate, broadly rhombic-spatulate, or elliptic, mostly rounded at the apex and broadly cuneate at the base, 2 5–8 mm broad, 4–12 mm long, fleshy, glaucous, indistinctly 3-nerved beneath, flowers numerous in short cluster-like racemes, pedicels 5–12 mm long; sepals slightly dissimilar, broadly elliptic, rounded, acutish, or faintly emarginate at the tip, 1 4–1 8 mm wide, 3–3 4 mm long, fleshy, glaucous, faintly veined, petals 2–3 mm long, bifid about to middle, usually with 2 short, rounded or truncate appendages at base of inner margin of each main lobe, stamens 1 8–2 mm long, about equaling the ovary, style 0 4–0 6 mm long, about one-fourth as long as the ovary, the stigma-lobes minute, capsule ovoid, about equaling the sepals, seeds about 0 8 mm long, obovoid-reniform, minutely reticulate in longitudinal lines, black, dull

Type locality.—Cape San Lucas, Baja California, Mexico

Distribution—Sandy soil and along washes, Cape Region, Baja California

Specimens examined —Cape San Lucas, *Hinds,* 1841, (K, type), Cabo San Lucas, *Shreve 7258,* (D), on beach sands, between the town of Cabo San Lucas and the end of the peninsula, *Whitehead 906,* (D), seashore, Todos Santos, *M E Jones 27046,* (D, UC), San José del Cabo, *Purpus 265,* (UC), *Anthony,* Mar–June, 1897, (UC), *Brandegee,* Oct. 7, 1890, and Nov, 1902, (UC).

In commenting on *D holosteoides,* Johnston wrote (Proc Calif Acad Sci IV 12 1024 1924), "*Drymaria crassifolia* is a very closely related form known only from San José del Cabo, and with little more than its perennial habit to distinguish it " It seems to me that the heavily glaucous herbage, the shorter stamens, the shorter petals with less strongly fimbriate appendages, the shorter internodes and matted habit, are characters of sufficient magnitude to warrant retaining *D crassifolia* as a distinct species Further field work may bring to light additional localities in which it grows

3 **Drymaria pachyphylla** Wooton and Standley, Contr U S Nat Herb 16 121, 1913

(Plate 20, figs 13–19)

Annual, with slender, spreading, prostrate stems 3–15 cm long, the internodes 2–12 cm long, much surpassing the leaves, which often are confined to terminal tufts; leaves mostly pseudoverticillate in 4's, the bases of each

pair connate in a narrow, scarious membrane, petioles slender, 5–7 mm long, blades broadly elliptic, rhombic-ovate, or broadly ovate, 3–11 mm wide, 5–14 mm long, somewhat fleshy, green or faintly glaucous, indistinctly 3-nerved; flowers in small, racemose clusters, about 3–15 flowers on each short rachis, each subtended by a narrowly ovate, hyaline bract 1 5–2 mm long; pedicels 1–4 mm long, sepals broadly ovate, 1 5–2 mm wide, 2 5–3 mm long, rounded at the apex, green and herbaceous, with membranous, white margins about 0 2 mm wide, petals about equaling or slightly shorter than the sepals, bifid one-third of way to base, each lobe bearing a broad, blunt appendage half as long as itself near the base of the inner margin, stamens 1–1 2 mm long, half as long as the ovary, style 0 2 mm long, the stigmas scarcely longer, capsule broadly ovoid to subglobose, about equaling the sepals, yellowish to pale brown, seeds 0 6–0 8 mm long, minutely granular-tessellate, dark brown, dull

Type locality —On the plains south of the White Sands, Doña Ana County, New Mexico

Distribution —Sandy soil, southeastern Arizona, through New Mexico to western Texas and in adjacent Mexico.

Specimens examined —Arizona Chiricahua Mts, *M E Jones*, Sept 22, 1931, (D, UC) New Mexico plains south of the White Sands, Doña Ana Co, *Wooton 405*, (D, UC, isotypes) Mexico Torreón, Coahuila, *Purpus 472*, 1903, (UC), Filipinas, Coahuila, *Purpus 4942*, (UC)

This is the species that Sereno Watson (Proc Am Acad 17 329 1882) listed from Coahuila as *D crassifolia*

4 **Drymaria carinata** Brandegee, Zoe **2** 70, 1891

(Plate 20, figs. 27–31)

Annual, with erect or ascending, weak, slender stems and glabrous herbage (sparsely puberulent in the variety), stipules narrowly subulate, 2–4 mm long, white, subpersistent, leaves broadly ovate, the blades 14–16 mm long, 5–18 mm wide, apiculate, from broadly cuneate to shallowly cordate at the base, thin, finely but distinctly 3-veined, bright green above, slightly paler beneath, petioles half as long as the blades to equaling them, inflorescence loosely cymose, peduncles and pedicels filiform, pedicels 2–8 mm long, each subtended by an ovate, acute, scarious bract 1–1 5 mm long, sepals broadly ovate-lanceolate, strongly incurved, bluntly carinate, 2–2 5 mm long, the green midvein narrow, petals 1 5–2 5 mm long, bifid two-thirds of way to base, the lobes lanceolate to narrowly spatulate, entire or faintly emarginate, devoid of marginal appendages, the claw narrow, stamens about equaling or slightly exceeding the sepals, filaments linear, ovary 1–1 2 mm high, short-stipitate; capsule subglobose, about equaling the sepals, seeds obovate-reniform, 0 4–0 6 mm long, deep amber to light brown minutely tessellated

Type locality —Sierra de la Laguna, Baja California, Mexico

Distribution —Mountains of southern Baja California

Specimens examined —Sierra de la Laguna, *Brandegee 34*, Jan 21, 1890, (UC, type), Laguna Mts, *M E Jones 24193*, (CA); Sierra de la Trinidad, *Brandegee*, Nov. 1902, (UC), Miraflores, *Brandegee*, Oct 14, 1890, (UC), El Taste, *Brandegee*, Sept 14, 1893, (UC), San Felipe, *Purpus 488*, 1901, (UC), under overhanging rocks, sides and bottoms of wash 22 miles south of La Paz, *Wiggins 5610*, (D)

4a **Drymaria carinata** Brand var **perennis**, Wiggins, var nov

(Plate 20, figs 32–34)

Ab *D carinata* typica radicibus perennibus, caulibus basim lignosis, nodis sparse minutissimeque scaberulosis, lobis petalorum latis curtisque differt

Type specimen, deposited in the Dudley Herbarium, Stanford University, no 263280, was collected in humus on cliff of rocky canyon slope, in oak-pine forest, **La Laguna, Sierra de la Laguna, alt. 6000 feet, Baja California, Mexico,** *H S Gentry 4415*, March 25, 1939

Additional specimen examined —Sierra de San Francisquito, *Brandegee*, March 30, 1892, (UC)

There is a clearcut and constant difference between the shape and size of the petals of the variety *perennis* and of those of the typical annual form (Pl 20, figs 30, 32–34) The lobes of the former are distinctly broader in comparison with the length, are practically the same width from base to tip, and are more nearly parallel than are those of *D carinata* In *perennis*, the claw is shorter and broader, and flares more abruptly to the blade than in the typical material

5 **Drymaria polystachya** Brandegee, Zoe **2** 70, 1891

(Plate 21, figs 2–5)

Perennial from a gnarled or tortuous, woody root, stems slender, spreading to ascending, 1–3 dm long, freely branched, sparingly to moderately pilosulous or glabrate, herbage pubescent and slightly glandular, stipules linear-subulate, 1–2 mm long, leaf-blades broadly cordate, 6–20 mm wide, 6–15 mm. long, the apex abruptly short-acuminate or acute, subsessile or on petioles 2–7 mm long, inflorescence of terminal and subterminal cymules, peduncles slender, 1–8 cm long, a pair of narrowly ovate, scarious bracts 1 6–2 2 mm long at each node of the inflorescence, pedicels subfiliform, 0 6–2 cm long, sepals subequal, oblong-elliptic, 1 5–1 7 mm wide, 4 5–5 5 mm long, obtuse or rounded and erosulate at the apex, the broad greenish central portion glabrous or sparingly puberulent, faintly 3-nerved, the margins scarious; petals bifid about to the middle, 5 5–6 5 mm long, devoid of appendages, the claws narrow, about 2 mm long, naked, stamens about 3 mm long, ovary ovoid, nearly equaling the stamens, capsule 3 5–4 5 mm long, seeds obovoid-reniform, slightly compressed laterally, brown, finely tessellated in numerous longitudinal rows

Type locality —Cliffs near San José del Cabo, Bàja California, Mexico

Distribution:—Among rocks and on cliffs, southern Baja California

Specimens examined —San José del Cabo, *Brandegee 35*, Mar. 14, 1890, (UC, type, D, isotype), *Brandegee*, March 10, 1892, (UC), *Grabendörfer*, March, 1899, (UC); Sierra de la Trinidad, *Brandegee*, Nov., 1902, (UC).

Brandegee described the leaves as " . 1 cm or less broad, ½ cm long, on petioles of nearly the same length." However, most of the leaves are subsessile or on petioles only 2–3 mm. long

The date on the type in the herbarium of the University of California reads "March 14, 1890," and the label bears the number "35" A specimen in the Dudley Herbarium also bears the number "35," but is dated, "March 24, 1890" It is not clear whether the discrepancy in the dates on the two specimens is a clerical error made in copying the labels, or two separate collections are involved I am inclined toward the former explanation No mention of the habitat is made on either label, so one must rely solely upon Brandegee's statement in the original publication for the information that the plant grew on "cliffs" near San José del Cabo.

5a **Drymaria polystachya** Brand var. **diffusa** (Rose) Wiggins, comb nov

(Plate 21, figs 6–8)

Drymaria diffusa ROSE, Contr U S Nat Herb 1·130 *pl. 12*, 1892

Annual, with weak, spreadingly-ascending stems, glandular-puberulent throughout, leaves with very slender petioles 4–10 mm long, the blades 3–10 mm wide, 3–8 mm long, truncate or broadly cuneate at the base, sepals narrowly oblanceolate, about 3 5 mm long, petals 4 5–5 mm long, otherwise as in the typical form of the species.

Type locality:—Carmen Island, Baja California, Mexico

Distribution:—Known only from Carmen Island and the mainland of Baja California immediately adjacent.

Specimens examined —Carmen Island, *Palmer 819*, Nov 1–7, 1890, (UC, 2 isotypes), shady talus slope under basaltic cliffs, above Punta Escondido, Sierra Giganta, alt 2000 to 3000 feet, *Gentry 3761*, (UC)

6. **Drymaria debilis** Brandegee, Proc Calif Acad. Sci II **2**.131, 1889

(Plate 21, figs 9, 10)

Annual, stems subfiliform, weak, spreading-ascending or scandent, 1–2.5 dm long, sparingly pilosulous, the internodes 3–4.5 cm long; stipules linear-subulate, somewhat tortuous, 1–1 5 mm. long, petioles slender, 2–10 mm long, pilosulous, leaf-blades broadly ovate, 3–10 mm long and wide, acute or abruptly short-acuminate at the apex, abruptly and broadly cuneate or truncate at the base, sparingly pilosulous on both sides or glabrate above; inflorescence loosely cymose, pedicels filiform, 4–14 mm. long, sparsely pubescent, sepals 2.6–3 2 mm long, pilosulous, ovate-acuminate, or the scarious wings obtusish at the apex, faintly 3-nerved, petals 3.8–4 2 mm. long, bifid about to the middle, the lobes broadly spatulate, the claws narrow and naked, stamens about equaling the sepals, the filamentas linear, flattened; capsule ovoid, nearly equaling the sepals, seeds reddish brown, obovoid-reniform, 0 6–0 8 mm. long, minutely tessellate in fine, longitudinal lines

Type locality: Purísima, Baja California, Mexico

Distribution:—Known only from the type locality

Specimens examined·—Purísima, *Brandegee*, Feb 13, 1889, (UC, type)

In general appearance *D debilis* closely resembles *D carinata*, but differs from that species in having acute, broader sepals that are not at all carinate; more pronouncedly pilosulous herbage, and somewhat shorter petals The crinkled hairs of the pubescence are often 1–1 2 mm long, but there are very few glandular hairs mixed with the non-glandular ones The paucity of glands helps to separate *D debilis* from *D polystachya* and its variety, *diffusa*

7 **Drymaria Fendleri** S Wats Proc Am Acad **17** 328, 1882

(Plate 21, figs 11–19)

Drymaria Fendleri var *perennis* M E Jones, Extract from Contr West Bot **18** 66. 1933

Erect or ascending annual (rarely biennial or perennial under favorable conditions) with glandular-puberulent herbage, stems slender, 1–3 5 dm long, internodes to 12 cm. long, stipules bifid into linear-subulate lobes 1 5–2 mm long, persistent; leaves thin, broadly ovate or ovate-cordate, 4–15 mm long, 6–22 mm wide, acute or rounded but abruptly apiculate at the apex, truncate or shallowly cordate at the base, on slender petioles 2–7 mm long, the margins often crinkling on drying, inflorescence cymose, peduncles slender, 1–6 cm long, usually strongly glandular-puberulent, bearing a pair of ovate, scarious bracts 2–2.5 mm long at the node, pedicels slender, 1–2 mm long, or some flowers subsessile in 2–5-flowered clusters, sepals lanceolate, 1–1 4 mm wide, 4–5 mm long, strongly 3-ribbed, acute to acuminate, the central portion green, glandular-puberulent, marginal wings scarious, petals 3 5–4 mm long, bifid about to the middle, the lobes linear-spatulate, claws narrow and naked; stamens half as long as the petals, capsule ovoid, 2–2 5 mm high, 8–15-seeded; seeds obovoid-reniform, 0 6–0 8 mm long, reddish brown, minutely tessellated in longitudinal rows

Type locality:—"New Mexico"

Distribution.—Foothills and mountains, New Mexico and Arizona to central Mexico, and the Cape Region of Baja California

Specimens examined·—New Mexico without further locality, *Fendler 60*, 1847, (G, type); *Thurber 1073*, (G), *C Wright 866*, 1851, (G), La Cuesta, *Bigelow*, 1853, (G); (all of the foregoing specimens are mounted on a single herbarium sheet, and all were cited by Watson in his original description); Silver City, *E L Greene*, Sept 14, 1880, (UC), granite hills, Kingston, Sierra County, *Metcalfe 1378*, (CA), under junipers, mountain slope near San José, San Miguel County, *Barneby 2627*, (CA) Arizona amid big boulders, Prescott, *Eastwood 16885*, (CA); near Prescott, *Kusche*, Sept. 1–5, 1929, (CA) Baja California, Mexico Cota Ranch, Laguna Mts., 14 miles E. of Todos Santos, *M E Jones 27050*, (D, UC, isotypes of var. *perennis* Jones); Saucito, near Sierra San Francisquito, *Brandegee*, Oct 14, 1893, (UC); Sierra de la Laguna, *Brandegee*, Jan. 21, 1890, (UC), Miraflores, *Brandegee*, Oct. 14, 1890, (UC); Arroyo Hondo, Sierra de la Laguna, *Brandegee*, Oct 22, 1893, (UC), San Felipe, *Purpus 469*, Jan.–March, 1901, (UC) Sonora, Mexico· San Bernardo, Rio Mayo, *Gentry 1338*, (UC).

The specimens from Baja California are slightly more robust than those from Arizona and New Mexico, but in qualitative characters the southern and northern specimens are identical A careful search revealed no morphological characters accompanying the perennial habit of Jones' material, so his variety, *D Fendleri* var *perennis* is reduced to synonomy under this species

8 **Drymaria viscosa** S Wats ex Orcutt, West Am Sci **2** 57, 1886, nomen nudum Proc Am Acad **22** 469, 1887

(Plate 21, figs. 20–27)

Annual with prostrate or spreading branches, dichotomously branched stems 5–20 cm long, and glandular-puberulent leaves, pedicels, and sepals, internodes to 6 cm long, glabrous or sparsely glandular-puberulent, stipules filiform-subulate, 1–1 5 mm long, glandular, leaves often pseudo-verticillate, linear to linear-oblanceolate, 1 5 mm wide or less, to 15 mm long, acute or obtuse at the apex, gradually narrowing to a slender petiole 1–3 mm long, inflorescence cymose, peduncles subfiliform, to 3 5 cm long, pedicels 1–3 mm long or some flowers subsessile, sepals narrowly to broadly elliptic, 0 6–1 2 mm wide, about 2 5 mm long, the green midrib ending in an excurrent apiculation slightly below the apex of the scarious, glabrous part, petals bifid about two-thirds of the way to the base, 2 mm long, the linear-spatulate lobes and narrow claw naked, stamens about 1 mm long, equaling the ovary, style half as long as the ovary, capsule broadly ovoid, nearly equaling the sepals, seeds obovoid-circinate, 0 6 mm high, pale cream, with light amber angles and dorsal band, smooth or slightly wrinkled, but not tessellate nor muriculate, dull

Type locality—Socorro, northern Baja California, Mexico (Misspelled "Socono" in the original publication)

Distribution —In sandy soil from about 30° 20′ N Lat (vicinity of San Quintín) southward to the Cape Region, Baja California

Specimens examined —Socorro, *Orcutt 1330*, (G, type, D, UC, isotypes), Lagoon Head, *Palmer 767*, March, 1889, (CA), Magdalena Island, *Orcutt 51*, March, 1917, (CA), *Brandegee*, March 13, 1889, (UC), mainland near Ascension Island, *Anthony*, April 17, 1897, (UC), Calmallí, *Purpus*, Jan –March, 1898, (UC), along beach on sand dunes, 4 miles south of Guadalupe, *Whitehead 830*, (D), sandy wash 27 4 miles south of Pozo Alemán, *Wiggins 7862*, (D); San Gregorio, *Brandegee*, Feb 1, 1889, (D)

The light colored, nearly or quite smooth seeds and the heavily viscid herbage of this species are distinctive In general appearance the plant resembles *Mollugo cerviana* (L) Seringe

9 **Drymaria sperguloides** A Gray, Am Acad. Arts and Sci Mem II **4**:11, 1849

(Plate 21, figs 28–38)

Mollugophytum sperguloides M E JONES, Extract from Contr. West Bot. 18.35 1933

Slender, erect, simple or dichotomously branched, glabrous annual 0 5–2 dm high, leaves in fascicles of 4–6, pseudo-verticillate, linear, 0 5–3 cm. long, the stipules triangular-subulate, 1–1 5 mm long, scarious, flowers in terminal and subterminal cymules, on peduncles 0 5–2 5 cm long, pedicels subfiliform, 1–5 mm long, sepals dissimilar, narrowly to broadly elliptic, 1–1 5 mm. wide, about 2 5 mm long, cuculate, 1-nerved, the apex rounded or obtuse, central green portion terminating slightly below the apex of the scarious margins, glabrous, petals 2–2 5 mm long, bifid about to the middle, 2 linear appendages two-thirds as long as the main lobes arising at the bottom of the sinus, claw winged, nearly as broad as the blade, stamens about 1 mm long, three-fourths as long as the ovoid ovary, stigma-lobes subsessile, capsule broadly ovoid to subglobose, 3–5 mm long, exceeding the sepals, seeds obovoid-circinate, not compressed, 1–1 2 mm long, dark brown, dull, minutely rounded-tuberculate in longitudinal rows

Type locality —"Valley of Santa Fé Creek in the mountains," New Mexico

Distribution —Mountain slopes and meadows, Arizona to western Texas and northern Chihuahua

Specimens examined —New Mexico without further locality, *Fendler 55*, 1847, (G, type), *C Wright 867*, (G, UC), Mogollón Mountains, on or near west fork of Gila River, Socorro County, *Metcalfe 349*, (D) Texas near Presidio del Norte, *Parry*, (G) Arizona· Patagonia Mts, *Kearney and Peebles 10042*, (UC), near San Francisco Mts, *Fulton 7368*, (CA), Eastview, Rincon Mts, *Blumer 3583*, (D), Barfoot Park, Chiricahua Mts, *Blumer 1433*, (D) Chihuahua, Mexico hills and mesas near Guerrero, *Pringle 1102*, (D)

The label on the type sheet bears no locality other than "Novo-Mexicanae," but the inscription "*Drymaria sperguloides* n sp" is in the handwriting of Asa Gray, and it is assumed that the more detailed locality data were obtained by him from Fendler's notes or through correspondence

The large capsules and seeds are distinguishing characters The pseudo-verticillate arrangement of the leaves is sufficient, even in young plants, to separate it from *D tenella* and *D effusa*, both of which have linear leaves and a similar habit

10 **Drymaria arenarioides** Willd in Roem and Schult Syst Veg 5 406, 1819

(Plate 21, fig 39, Plate 22, figs 1–8)

Drymaria frankenioides H B K Nov Gen et Sp 6 21, *pl 516*, 1823

Prostrate, glandular-puberulent, canescent, short-lived perennial with profusely branched stems 3–20 cm long, stipules subulate, 1–1 5 mm long, persistent, slightly glandular-puberulent; leaves more or less fasciculate, linear-lanceolate to narrowly elliptic, 1–2 5 mm wide, 5–15 mm long, granular-puberulent and slightly canescent, acute, tapering gradually to a short, slender petiole 1–2 mm long, flowers axillary and in terminal, 1–3-flowered cymules, pedicels slender, 3–10 mm long, often deflexed in fruit, sepals dissimilar, narrowly lanceolate to ovate-lanceolate, 1–2 2 mm wide, 5–6 mm long, acute to short-acuminate, weakly 1-nerved, the margins scarious; petals 5–6 5 mm long, divided into 6 lobes about to the middle, the main, outer ones

1–1.2 mm wide, the inner 4 in 2 pairs of filiform appendages slightly shorter than the main lobes, stamens about 1 5 mm. long, equaling the ovary; style half as long as the ovary, capsule ovoid, 4–5 mm long; seeds orbicular-circinate, slightly compressed laterally, with a pronounced, broad, dorsal groove and deep lateral depressions, uniformly and minutely granular-tessellate, dull, brown

Type locality.—Pachuca, Mexico

Distribution:—Northern Sonora and Chihuahua and southward into central Mexico

Specimens examined —Chihuahua· hills and plains near Chihuahua (City), *Pringle 715,* (UC), Chihuahua, *Purpus 1163,* (UC) Sonora gravelly slopes 20 miles south of Llano, *Wiggins 7235,* (D), *Shreve 7322,* (D), southern edge of oak belt 35 km south of Nogales, *Ferris 8810,* (D), rocky benches, Nogales road, about 1 mile north of Cumetál, *Abrams 13178,* (D) Hidalgo Ixmiquilpan, *Purpus 483,* Feb, 1905, (UC) Zacatecas *Purpus 133,* 1908, (UC)

The filiform central lobes of the petals are surprisingly uniform in length, width, and point of insertion. There is a visible vascular strand, similar to those running to the main lobes, leading to each pair of the appendages These bundles depart from the main petal bundle just below the sinus

The seeds are distinctive in that the tessellations are not arranged in rows, but form a low, close mosaic over the whole surface The broad, dorsally grooved back, and the tight coil of the embryo are noteworthy also

11 **Drymaria peninsularis** Blake, Journ Wash Acad Sci **14**.285, 1924

(Plate 22, figs 9–16)

Prostrate, decumbent, or ascending annual, or sometimes persisting as a perennial, with many freely branched stems 0 5–2 dm long, herbage pale green or slightly glaucescent, glandular-hirtellous throughout, internodes 2–25 mm long, stipules scarious, undulate, entire, 0 6–0.8 mm long, leaves linear, somewhat fleshy, sessile, obtuse or rarely acute, lower ones 1–2 5 cm long, the upper rarely over 4 mm long, shorter than the internodes, flowers solitary in the axils from about the middle of the stems to the apex, pedicels 2–12 mm long (in fruit), erect to strongly deflexed; sepals slightly dissimilar, narrowly to broadly ovate-oblong, 1–2 mm wide, 3 5–4 mm long at anthesis, 4–4 5 mm. long in fruit, obtuse or rounded, obscurely 1- or 3-nerved, the central part green, herbaceous and glandular-puberulent, the margins scarious, glabrous; petals white, 3 5–4 mm long, curved, so just equaling the sepals, 4–5-fid nearly to the middle, the outer lobes broader and longer than the central ones, claws slightly dilated and erosulate near the base, nearly as broad as the limb, stamens about two-thirds as long as the sepals, slightly surpassing the ovary, style and stigmatic lobes about equal, capsule ovoid, 3–4 mm. long; seeds round-reniform, plump, 0 7–0.9 mm long, fuscous, finely and bluntly tessellate, the bosses near the base of the dorsal surface in longitudinal rows, not aligned elsewhere.

Type locality:—Cape Region, Baja California, Mexico.

Distribution·—Known only from the Cape Region of Baja California, Mexico

Specimens examined. Cape Region, *Purpus 423*, (UC, isotype), Cabo San Lucas, *Brandegee 30*, March 17, 1892, (D, UC), *Brandegee*, Nov, 1902, (UC), Canyon Salado, *Purpus 337*, (UC), coast south of Pescadero, *Brandegee*, Nov, 1902, (UC), Arroyo Salado (San José del Cabo), *Purpus 496*, (UC), El Taste, *Brandegee*, Sept 11, 1893, (UC), Cabo San Lucas, *Johansen 541*, (D)

The leaves are narrower and the upper ones more reduced in *D peninsularis* than they are in *D arenarioides*, with which the former was long identified The sepals of *D arenarioides* are more acute than they are in *D peninsularis*, and the appendages in the sinuses of the petals are longer and narrower in the former species than they are in the latter The seeds of the two species are quite similar

12 **Drymaria Johnstonii** Wiggins, sp nov

(Plate 22, figs. 17–21, 36)

Planta annua gracilis, ramulis decumbentibus vel ascendentibus glaucis 5–10 cm longis glanduloso-puberulentibus, stipulae subulatae 0 5–0 8 mm longae, folia opposita vel fasciculata linearia subcarnosa 2–5 mm longa sessilia apicem obtusa vel rotundata, flores axillarii solitarii, sepalis 2 2–2 5 mm longis ellipticis obtusis, margine membraneis, petalis semibifidis 2 5–3 mm longis albis nudis sepala vix superantibus, staminibus ovarium vix superantibus, ovarium 1 mm altum, capsula anguste ovata 2 5–3 mm longa sepala vix superantia; semina 2–5 nigra obovata minute granulo-muriculata 0 6 mm longa

Annual with freely branching, slender, decumbent or spreadingly ascending stems 1–1 5 dm long and slightly fleshy, glaucescent leaves, puberulent throughout with stout, short-stipitate, whitish glandular and simple hairs, internodes 5–14 mm long, stipules subulate, scarious, 0 5–0 8 mm long, persistent, leaves opposite or the lower ones sometimes fasciculate, linear, slightly fleshy, 2–5 mm long, or basal ones up to 1 cm long, faintly 1-nerved, sessile, rounded or obtuse at the apex, flowers axillary, solitary, pedicels slender, 1–2 mm. long at anthesis, 4–8 mm long in fruit, sepals herbaceous-fleshy, 2 2–2 5 mm long, elliptic, obtuse at the apex, the scarious, hyaline margins evident on the inner sepals and the covered edges of the outer sepals, petals white, bifid nearly to the middle, devoid of appendages, 2 5–3 mm long, slightly surpassing the sepals; stamens equaling or slightly surpassing the ovary, style 0 2 mm. long or less, much exceeded by the stigma-lobes, capsule narrowly ovoid, acute, 2 5–3 mm long, equaling the sepals or slightly exceeding them, 2–5-seeded; seeds black, 0 6 mm long, obovoid-reniform, minutely and uniformly granular-muriculate, dull

Type in the herbarium of the California Academy of Sciences no 82814, collected in crevices of rock on mesa near crest of island, the isthmus, Espiritu Santo Island, Baja California, Mexico, *Ivan M Johnston 3972*, May 31, 1921

Only one plant was seen and the species has not been re-collected Johnston (Proc Calif Acad Sci [IV], 12 1023, 1924) determined it, tentatively, as *D arenarioides* and stated that the plant seemed undescribed He also said that the plant on the mainland of Baja California which had been called *D arenarioides* was different, both from his Espíritu Island plant and the material called *D arenarioides* from eastern Mexico Subsequently S F Blake described the peninsula plant as *D peninsularis*, but he did not have access to this material of Johnston's

D Johnstonii closely resembles a depauperate plant of *D peninsularis*, but differs from that species in having few leaves over 4–5 mm long, petals entirely devoid of appendages, and in having seeds that are less tightly circinate, ungrooved dorsally, and in being much more finely muriculate over the whole surface

13 **Drymaria effusa** A Gray, Pl Wright 2 19, 1853

Slender annual 0 8–2 dm high, dichotomously branched above the second or third nodes, minutely puberulent, or the internodes becoming glabrate, internodes 2–4 cm long, or the lowest slightly longer, stipules filiform-subulate, 1.5–2 2 mm long, entire, basal leaves obovate-spatulate, 1 5–3 mm wide, 3–10 mm long, rounded, broadly cuneate at the base, green, sparsely puberulent, on petioles 1–2 mm long, or subsessile, cauline leaves filiform or narrowly linear, sessile, 1–2 5 cm long, or the uppermost reduced, faintly 1-nerved, minutely puberulent, flowers solitary in the axils of the upper leaves and of scarious, ovate bracts 0 5–1 5 mm long, pedicels filiform, 2–4 mm long, sepals ovate, slightly dissimilar, 1 4–1 8 mm long, obtuse or rounded at the apex, inconspicuously 1-nerved, minutely but closely puberulent, the winged margins scarious, petals bifid almost to the center, 2–2 8 mm long, exceeding the sepals, devoid of appendages, claws narrow and naked, stamens about equaling the sepals, ovary 1 mm high, style 0 4–0 6 mm long, about equaled by the filiform stigma-lobes, seeds (immature) reddish brown, muriculate

Type locality—"Mountains east of Santa Cruz, Sonora "

Distribution—Mountains in Santa Cruz, Cochise, and Pima counties, Arizona, and southward into adjacent northern Sonora

Specimens examined —Sonora mountains east of Santa Cruz, *C Wright 869*, Sept, 1851, (G, type) Arizona Babocomari, Santa Cruz County, *Thurber 995*, (G), Sonoita Valley, *Rothrock 169*, (G), "S Arizona," *Lemmon 509*, 1881, (G), Huachuca Mountains, *Price*, Aug 14, 1895, (D)

14 **Drymaria tenella** A Gray, Mem Am Acad II 4 · 12, 1849

(Plate 22, figs 22–27, 34)

Erect, slender annual 0 5–2 dm high, dichotomously branched above the second or third node, glabrous, or glandular puberulent in the variety; internodes to 3 5 cm. long; basal leaves spatulate-obovate, 1–2 5 mm. long on pedicels of equal length; cauline leaves linear, sessile, 3–15 mm. long, acute, inconspicuously 1-nerved, glabrous, stipules white, scarious, linear-subulate, 1 mm long or less, erect, flowers short-pedicellate or subsessile in the axils or terminal on slender peduncles 5–10 mm long, sepals ovate-lanceolate, 0.8–1 2 mm wide, 2 8–3 2 mm long, acute, strongly 3-ribbed, the margins scarious, petals white, 2 3–2 8 mm long, bifid to middle or slightly below, *the lobes oblong,* entire or minutely emarginate, devoid of appendages, claws narrow and naked, stamens slender, about equaling the 1–1 3 mm high ovary, style 0 2–0 4 mm long, stigmatic lobes about as long; capsule ovoid, about 2 mm high, 8–12-seeded, seeds obovoid-reniform, 0 6–0 8 mm long, minutely but sharply muriculate, reddish brown.

Type locality —Eight miles west of Las Vegas, New Mexico

Distribution —Mountains of Arizona, New Mexico, and adjacent Chihuahua and Sonora, and in northern Baja California, Mexico

Specimens examined —New Mexico eight miles west of Las Vegas, *Fendler 56*, Aug , 1847, (G, type), Pinos Altos Mts , *E L Greene 332*, Sept 8, 1880, (G), Sawyer's Peak, Grant County, *Metcalfe 1428*, (CA), without definite locality, *C Wright 868*, 1851, (G) Arizona Manning Camp, Rincon Mts , Pima County, *Blumer 3368*, (D), rhyolite spur just N of Wilgus Ranch, Chiricahua Mts , Cochise County, *Blumer 1639*, (D), Barfoot Park, Chiricahua Mts , *Blumer 1411*, (D) Chihuahua pine plains, base of the Sierra Madre, *Pringle 1194*, (D) Baja California, Mexico margins of meadow at La Encantada, Sierra San Pedro Martír, alt 2200 m , *Wiggins and Demaree 4916*, (D)

This species is very similar to *D effusa* in general appearance, but it is separated from that species by the acuminate sepals and the lack of puberulence on the herbage

14a **Drymaria tenella** A Gray, var **nodosa** (Engelm), Wiggins n comb

(Plate 22, figs 28–33, 37–38)

Drymaria nodosa Engelm apud A Gray, Mem Am Acad II 4 12, 1849

Upper parts of internodes, peduncles, pedicels and herbaceous portions of the sepals minutely glandular-puberulent, sepals short-acuminate, otherwise as in typical *D tenella.*

Type locality —Cosiquiriachi, Chihuahua, Mexico

Distribution —Northern Chihuahua and northeastern Sonora

Specimens examined —Chihuahua pine plains, base of the Sierra Madre, *Pringle 1195*, (D), thin soil, rocky hills near Chihuahua, *Pringle 716*, (D) Sonora Los Pinitos, alt 6100 ft , *Hartman 138*, (UC).

There are only two minor characters by which the variety can be separated from *D tenella,* and they are of insufficient value to warrant retaining this entity as a distinct species.

15. **Drymaria depressa** Greene, Leafl Bot Obs and Crit 1 153, 1905

(Plate 22, figs. 39–43)

Annual, freely branched plant with slender branches 2–4 cm long, depressed or spreading, glabrous, the internodes 0 5–2 cm long, stipules 0 5–1 2 mm. long, whitish, slightly curled, leaves oblanceolate, 1 5–3 mm wide, 5–13 mm. long, obtuse at the apex, gradually narrowing to the sessile base, glabrous, faintly 3-nerved; inflorescence of compact cymules; pedicels 1.5 mm. long or less, minutely granular-puberulent; sepals oblong, 2.2–2.6 mm long, rounded at the apex, narrowly scarious-margined, glabrous, distinctly 3-nerved, petals narrow, bifid to the middle, 2–2.2 mm. long, devoid of appendages, the claws narrow, naked; stamens slightly over half as long as the petals, and about equaling the ovary at anthesis; ovary short-stipitate; style nearly as long as the ovary, the stigma-lobes half as long, capsule narrowly ovoid, nearly equaling the sepals at maturity, 8–12-seeded; seeds obovoid-reniform, 0.6–0.8 mm long, light buff, uniformly and finely tessellate with low, rounded welts, dull

Type locality:—Sawyer's Peak, Grant County, New Mexico

Distribution:—Mountains in eastern Arizona and New Mexico

Specimens examined.—Open glade on Sawyer's Peak, Grant County, New Mexico, alt 9500 feet, *Metcalfe 1430*, (CA, isotype).

Kearney and Peebles suggest that this species may not be distinct from *D. effusa*, but it seems to me that the broader leaves, compact habit, and lack or paucity of puberulence separates it from that species I have not seen the Arizona material.

EXPLANATION OF PLATES

PLATE 20

Fig 1 Diagram of cymose inflorescence common in *Drymaria*.

Fig 2 Diagram of inflorescence of *D spergulоides*, solidly inked circles indicate abortive flowers

Fig 3 Diagram of aestivation of sepals in *Drymaria*

Figs 4–12 *D holosteoides*, figs 4–8, sepals, × 6 6, fig 9, petal, × 13, figs 10–12, × 6 6, fig 10, ovary and stamens, fig 11, ovary, fig 12, petal

Figs 13–19 *D pachyphylla*, × 6 6, fig 13, petal, fig 14, ovary and stamens, figs 15–19, sepals

Figs 20–26 *D crassifolia*, × 6 6, fig 20, ovary and stamens, fig 21, petal, figs 22–26, sepals

Figs 27–31 *D carinata*, figs 27–29, × 6 6, figs 30–31, × 13, fig 27, petal, figs 28–29, sepals, figs 30–31, petal and sepal from different plant

Figs 32–34 *D carinata* var *perennis*, × 13, fig 32, petal before anthesis, figs 33–34, petals from different plants at anthesis

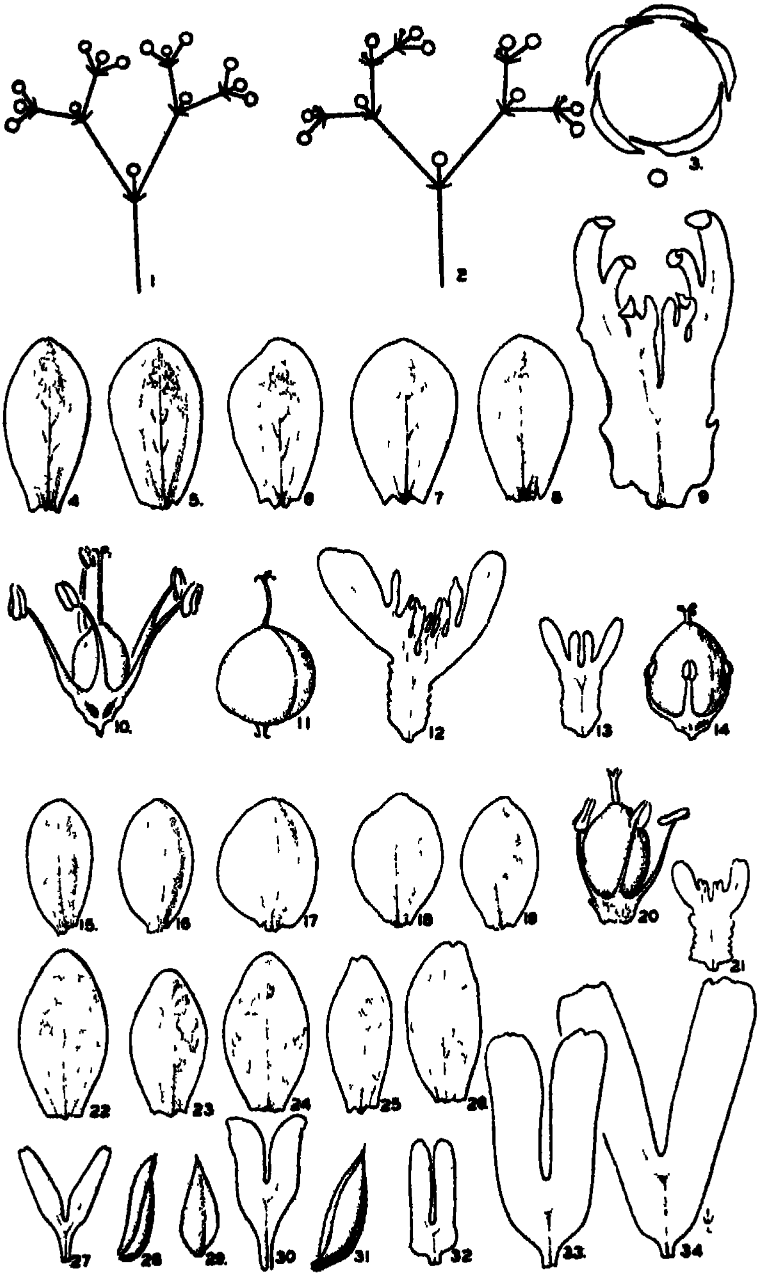
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PLATE 21

Fig 1 *D crassifolia*, × 6 6, arrangement of leaves at a node, the dotted lines indicate a hyaline "sheath" of epidermal and subepidermal cells overlying the photosynthetic tissue

Figs. 2–5 *D polystachya*, petal and sepals, × 6.6

Figs 6–8 *D polystachya* var *diffusa*, sepals and petal, × 6 6.

Figs 9–10 *D debilis*, petal and sepal, × 6 6.

Figs 11–19 *D Fendleri*, × 6 6, figs 11–12, petal and ovary and stamens from a flower from New Mexico; fig 13, mature capsule from same plant; figs 14–19, sepals and petal from plant from Baja California, Mexico.

Figs 20–27 *D viscosa*, × 13, fig 20, petal, fig 27, ovary and stamens, figs. 21–26, sepals (fig 22, lateral view of a sepal)

Figs 28–38 *D sperguloides*, × 13, figs 28–31, 35–36, sepals, figs 32–33, petals, fig 34, ovary and stamens, fig. 37, mature capsule and persistent sepals, fig 38, arrangement of leaves and branches at a node

Fig 39 *D arenarioides*, petal, × 6 6

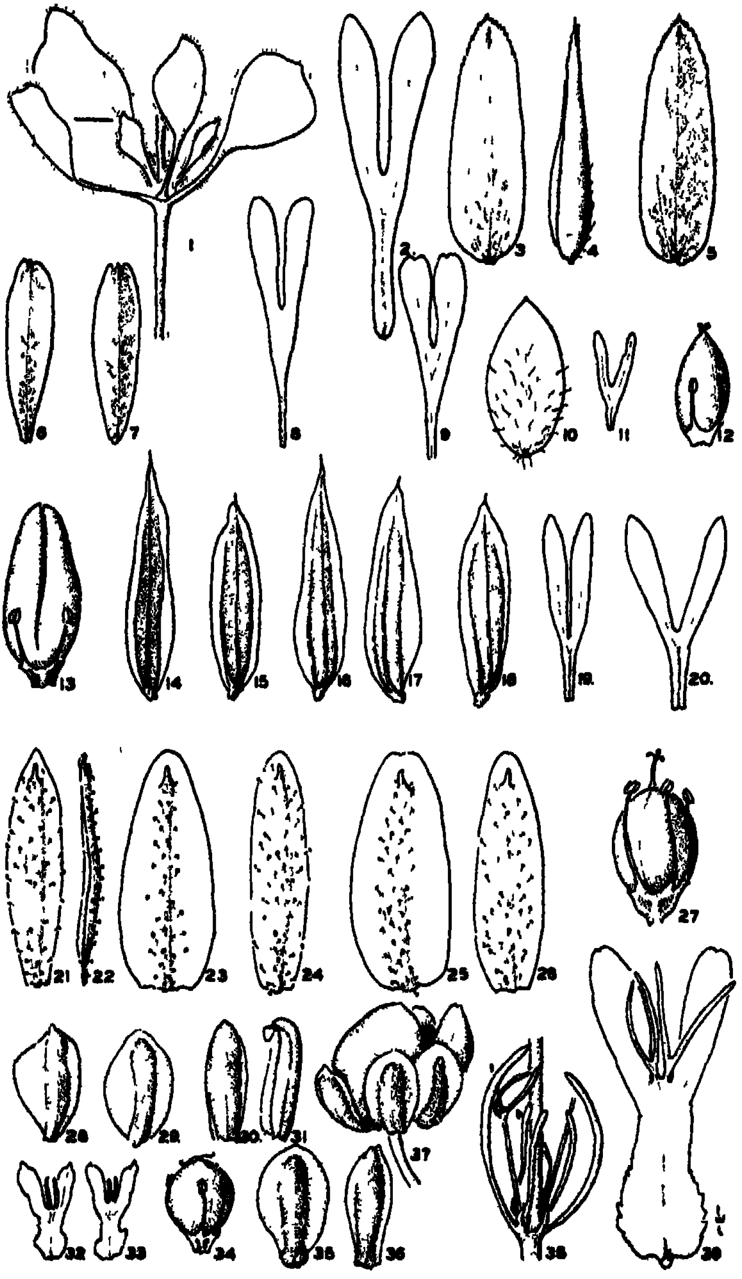


PLATE 22

Figs 1–8 *D arenarioides*, × 6 6, figs 1–5, sepals, fig 6, ovary and stamens, figs 7–8, petals

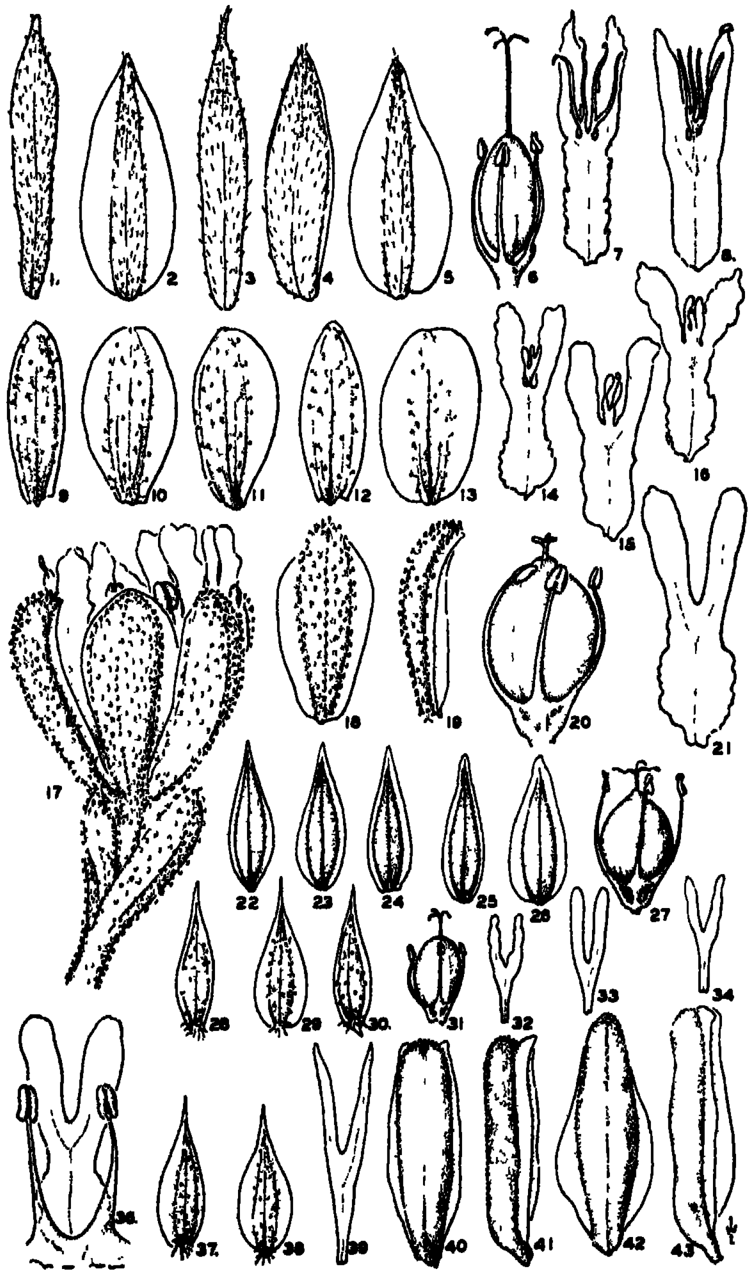
Figs 9–16 *D peninsularis*, × 6 6, figs 9–13, sepals; figs 14–16, petals

Figs 17–21, 36 *D Johnstonii*, × 13, fig 17, flower at anthesis, figs 18–19, sepals, fig 20, ovary and stamens, figs 21, 36, petals and adjacent stamens

Figs 22–27, 34 *D tenella*, × 6 6, figs 22–26, sepals, fig 27, ovary and stamens, fig 34, petal.

Figs 28–33, 37–38 *D tenella* var *nodosa*, × 6 6, figs 28–30, 37–38, sepals, fig 31, ovary and stamens, figs 32–33, petals.

Figs 39–43 *D depressa*, × 13, fig 39, petal, figs 40–43, sepals



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ALICE EASTWOOD
SEMI-CENTENNIAL PUBLICATIONS

No. 8

A PLEISTOCENE FLORA FROM THE McKITTRICK ASPHALT DEPOSITS OF CALIFORNIA

BY

HERBERT L MASON
Associate Professor of Botany and Curator of the Herbarium
University of California

THE KNOWN Pleistocene floras of California are largely coastal in their position and contain a group of species as fossils that are essentially maritime in their occurrence today Of these by far the richest as to species content are the Tomales flora (1) in Marin County and the Carpinteria flora (2) in Santa Barbara County Both of these contain a Monterey type forest dominated by pines and containing cypresses and live oaks as well as an understory of shrubs that is highly diversified as to genera and species The asphalt deposit at Rancho La Brea (3) in Los Angeles County, although near the coast, contains a flora that is essentially interior in its nature and is best represented today by the open woodland vegetation on the slopes of the Tehachapi Range The occurrence in this deposit of a few specimens of maritime species, however, suggests that at least a part of the drainage basin contributing to this deposit was populated by a maritime flora It seems most likely that a mountain range such as the Santa Monica Mountains lay between it and the sea and that the coastal slope of these mountains was covered by a maritime flora which extended over the top and a short distance down the interior side much as does the coastal pine forest today on Cedrus Island off the Lower California coast Only a very few strictly interior floras of Pleistocene age in California are as yet known and these contain very few species of plants We therefore know very little as to the nature of the interior California floras during Pleistocene time and hence welcome any information, however meager, that will help us to piece together a picture of the vegetation of the interior for this period of the earth's history

In the asphalt deposits at McKittrick in western Kern County, California, such a fossil flora occurs The McKittrick deposit is located at the southwestern edge of a small oil town of the same name in the southwestern San Joaquin Valley just east of the base of the Temblor Range The elevation of McKittrick is 300 feet while the Temblor Range rises to about 4000 feet The geology of the area has been reported by Arnold and Johnson (4) and will not be further treated here The rich fossil faunas have been described and discussed by Merriam and Stock (5, 6) for the mammals and by Miller (7, 8) for the birds Summaries of these latter papers are presented by Hay (9). Arguments as to the precise position of these beds in the Pleistocene have been presented and discussed at length by these authors The plant species that are at all critical in this respect all go back to the Pliocene both north and south of this area and are still living both north and south of this area and hence can throw very little light, if any, upon this problem The Pleistocene status of the flora is inferred from the associated fauna which is largely made up of now extinct species

The flora, however, does have a contribution to make as to the general ecological setting and can serve to a large extent in forming the basis for an interpretation of the habitat and the local climate for the portion of the Pleistocene represented It will fill out the ecological picture presented in part by the mammalogist and in part by the ornithologist

Merriam and Stock (5, 6) report the occurrence of horses, bison, camels, antelope, bear, lion, tiger, wolf, ground sloth and mastodon, all of which are now extinct These are largely plains or savanna types of animals Miller reports a list of thirty-five birds of which water birds predominate by two to one Only 10 per cent of the birds are now extinct

To date six identifiable plant species have been found These consist of two gymnosperms and four angiosperms Although the flora is meager these plants are sufficiently critical as to their climatic tolerance to serve as indicators of the nature of the flora and of the climate that prevailed in the McKittrick region during Pleistocene time. It may be that some future excavations will yield a flora comparable in quantity as well as in quality to other asphalt deposits in California but for the present we must be content with what there is

The plants are represented in the deposit by fragments of poorly preserved fruiting structures and seeds as well as scraps of partially disintegrated twigs These are imbedded in sand that has been impregnated with asphalt The advanced state of deterioration of so much of the plant material suggests that the impregnation of the asphalt occurred after the plants were deposited and after preliminary decomposition had set in There is not the evidence of a pool of asphalt such as is suggested by the conditions at Rancho La Brea As compared with equal volume of matrix from other asphalt deposits the plant material in the McKittrick is rare Most of the species are represented by single specimens In only one case, the *Atriplex*, is there sufficient material to give any notion as to the range of morphological variation of the structure Fortunately, however, most of the material is of such a nature as to be readily identifiable and the following species may be recorded

Pinus monophylla Torr
Juniperus californica Carr
Atriplex lentiformis (Torr) Wats
Arctostaphylos glauca Lindl
Arctostaphylos pungens H.B K
Echinocystis fabacea Naud

All of the above species found in the McKittrick flora are still living in the California flora today The occurrence of all of them in a single Pleistocene flora presents a harmonious ecological picture that is not unlike an assemblage in the modern flora of the eastern end of the San Rafael Mountains in northeastern Santa Barbara County, on the slopes of Santa Barbara Canyon a little above its entrance upon the Cuyama Valley (United States Geological Survey, Santa Ynez Quadrangle, R 25 W, T 9 N, in the Santa Barbara National Forest)

The San Rafael Mountains in this vicinity range from altitudes slightly in excess of 600 feet to altitudes near 7000 feet The great differences in altitude and the roughness of the terrain are reflected in great local diversity of the flora A profile section of the San Rafael Range in this region in the direction of the storm paths will help to explain why a region so close to the coast supports such an arid type of vegetation There are three prominent ridges separated by the canyons of Manzana Creek and the Sisquoc River The westernmost of these ridges reaches an altitude of 4000 feet at Zaca Peak directly above the 1500-foot Santa Ynez Valley. The canyon of Manzana Creek drops precipitously to 1700 feet The ridge between this canyon and the canyon of the Sisquoc River rises to a height of 3500 feet and is clothed with a very arid type of vegetation The canyon of the Sisquoc drops to 2300 feet and the third and highest ridge culminates in Pine Mountain at 6800 feet with a northward spur of about 5800 feet forming the west wall of Santa Barbara Canyon These ridges serve to force the moisture-laden winds from the ocean upward and causes them to deposit their load on the westernmost ridge and the upper part of the easternmost high ridge This condition is reflected in the vegetation of these ridges The western slope of the first ridge is clothed with a savanna type of cover except where the topography causes rapid runoff Here the vegetation is chaparral The top of this ridge is clothed with a forest of big cone spruce (*Pseudotsuga macrocarpa*), Coulter pine (*Pinus Coulteri*) and western yellow pine (*Pinus ponderosa*), which runs down the canyons and gullies on the east side The second ridge, as was pointed out above, is clothed with a very sparse, arid type of chaparral The third ridge is arid below the 4000-foot level but above is clothed with a very rich coniferous forest of big cone spruce, Coulter pine, western yellow pine and sugar pine (*Pinus Lambertiana*) It is the lower slopes of the east side of this ridge that contain the flora represented in the McKittrick asphalt deposit. Here is an arid type of flora of scattered stands of pinyon pine (*Pinus monophylla*) and California juniper (*Juniperus californica*) and patches of manzanitas (*Arctostaphylos glauca, A pungens* and *A Parryana*). The other species represented in the fossil flora are abundant on the lower slopes and in the Pleistocene were probably much closer to the site of deposition than were the larger shrubs and trees

Precisely where the particular plants that found their way to preservation in the McKittrick asphalt grew during Pleistocene time, is difficult to determine It seems probable, however, that they were a part of the flora that occupied the Pleistocene Temblor Range and were borne down by the streams to the ponds and lakes that ultimately became silted up and infiltrated with asphalt The pine, the juniper and the manzanitas, as well as the *Echinocystis*, probably occupied the higher slopes, while the *Atriplex* occupied alkaline flats near the ponds and marshes This occurrence would explain the abundance of *Atriplex* and the relative scarcity of the other species in the deposit, since these latter would have to be transported by a none too rich stream flow

Climatically the flora suggests an area of low rainfall but perhaps more than is received by the McKittrick region at the present time This might lead some to argue that the flora indicates at least glacial time, however, in view of the close proximity of a similar modern assemblage of species it is more logical to assume that some minor changes in topography to the west would have accomplished the same result during the Pleistocene at McKittrick If the Temblor Range were higher by 1000 feet, it might support such a flora around its summit Evidence as to glacial or interglacial time is negative so far as the McKittrick flora is concerned

Ecologically the flora is entirely consistent with the assemblage of mammals and of the birds It was sufficiently open to permit grazing and browsing and, although the presence of *Atriplex* does not necessarily mean ponds and lakes, it frequently occurs near such sites today

Since all of the plants represented in the McKittrick flora are modern species the nomenclature here used is that of the modern plants In one of the plants the nomenclature of the modern group is not as yet stabilized, owing to incomplete knowledge and hence uncertain taxonomic concepts In this instance it is felt that it is not within the province of this paper to solve these problems, nor could they be solved on the basis of the material here presented The nomenclature for this species therefore follows current usage The problem will be raised in connection with the species in question

The specimens here cited are all deposited in the Palaeobotanical Collection of the University of California at Berkeley

Pinus monophylla Torr

(Plate 23, fig 3)

Pinus monophylla Torr in Fremont, Second Report, 319, 1845

Pinus monophylla is represented by a cone, of relatively large size for this species, that is poorly preserved The structure is practically reduced to vascular tissue but enough of the surface features of a few of the scales is preserved to show the essential nature of the apophysis and of the umbo as well as to clearly indicate the size and shape of the seed cavity The cone is about 8 cm long and about 7 cm wide The scales are terminated by a somewhat recurved, quadrate apophysis bearing a dorsal umbo The seed cavity is ovoid, about 12 mm long and 8 mm wide, indicating a relatively large seed

Pinus monophylla ranges primarily to the east of the Sierra Nevada A few stations have been recorded for its occurrence on the west slopes of the Sierra It occurs also in the Tehachapi and the Mount Pinos region, and extends northward in the coast ranges to the Cuyama Valley in the San Rafael Mountains, and on the watershed of the headwaters of the Santa Ynez River

University of California Palaeobotanical Collections, Plesiotype no 2810

Juniperus californica Carr

(Plate 23, fig 1)

Juniperus californica Carr Rev Hort 352, 1854
Juniperus californica Carr. var *breaensis* Frost, Univ Calif Publ Bot 14 77, 1927

Juniperus californica Carr is represented in the fossil flora by a seed 8 mm long by 5 mm wide that in no way differs from seed of the modern species as it occurs in the Tehachapi Mountains today The seed coat is of medium thickness, and agrees with other Pleistocene material collected from the asphalt deposits at Rancho La Brea and described by Frost as distinct from the modern plants

The modern *J californica* Carr is an aggregate species that includes with varietal rank the desert and Great Basin form *J utahensis* (Engelm) Lemmon These two forms intergrade in the region of the Tehachapi Mountains so as to make their separation as distinct species impossible They have been separated on the basis of the glandular nature of the foliage of typical *J californica* Another important difference is the relative thickness of the seed coat in the extremes of the two forms Typical *J californica* has a thin seed coat while typical *J californica* var *utahensis* has a very thick seed coat Both the characters of the seed coat and of the glandulosity intergrade in material collected by the writer from the Tehachapi Mountains and from the Sierra Liebre in California (see *Mason 3737*, Herbarium of the University of California) The fossil material from the McKittrick asphalt is of the intermediate type represented by this material Because of its intermediate character it is impossible to designate whether it belongs to the species or to the variety.

In the fossil record *J californica* has been reported from the asphalt deposits at Carpinteria and at Rancho La Brea. In the latter flora, however, the material was described as new under the name *J californica* var. *breaensis* Frost *J californica* ranges from Lower California through the western Mojave Desert to the Tehachapi Mountains and northward in discontinuous patches in the inner coast ranges to Shasta County and sparingly on serpentine soil in the Sierra Nevada foothills to Butte County It is of interest to the present paper to record it in abundance in the inner south coast ranges that border the Cuyama Valley

University of California Palaeobotanical Collections, Plesiotype no 2811

Atriplex lentiformis (Torr) Wats

(Plate 24, figs. 1, 2, 3)

Atriplex lentiformis (Torr) Wats Proc Am Acad 9 118, 1874

The species is represented by a large number of fruiting bracts often enclosing fragments of the seed coats They are flattened and wedge-shaped Some of them possess a stipe while others appear to have been sessile on the branch They average 4 mm in length and 5 mm in width The bracts are united below over the seed and are apparently free above The upper margins are somewhat broken and it is difficult to reconstruct the character of these organs There is evidence to indicate a fringed, denticulate margin The surface shows a coarsely reticulate venation and is entirely devoid of any facial processes

It seems evident from a careful comparison of the specimens that but a single species of the genus is represented The great range of variation exhibited by many of the modern species shows forms that are not unlike the fossils However, each species has a characteristic kind of fruiting structure and its variation centers around this type Of the modern species now living in California, *A lentiformis* seems closest both on morphological and ecological grounds The area wherein this flora is best represented today is rich in species of *Atriplex* and any or all of them might well have been living in the McKittrick locality during the Pleistocene

The genus *Atriplex* has been recorded from the Pleistocene Tomales flora of central California where fossil material of the coastal species of *A hastata* has been collected

University of California Palaeobotanical Collections, Plesiotype no 2812

Arctostaphylos glauca Lindl.

(Plate 24, figs 4, 5, 6)

Arctostaphylos glauca Lindl Bot Reg sub t 1791, 1835.

This large-fruited species of manzanita is represented in the fossil flora by fragments of fruits one of which is 12 mm in diameter, with its carpels closely coalesced so as to present a very smooth surface The material is identical with similar structures on the modern *A glauca* and is clearly referable to that species

The modern plant is a characteristic species of the Upper Sonoran life zone in the blue-oak-digger pine belt, and ranges from central California southward to southern California It is frequent in the Tehachapi Mountains and the inner south coast ranges in association with juniper Its occurrence in the fossil flora suggests conditions similar to those of these mountains at an altitude of about 3000 feet

Arctostaphylos glauca is known in the Pleistocene from both the Carpinteria and the Rancho La Brea asphalt deposits It is an indicator of arid interior conditions (Chaney and Mason, 2)

University of California Palaeobotanical Collections, Plesiotype no 2813

Arctostaphylos pungens H B K

Arctostaphylos pungens H B K Nov Gen et Sp 3 278, 259, 1818

This species is represented in the fossil flora by a fruit 4 mm long and 6 mm wide with coalesced carpels The individual carpels show unequal development and present a strongly ribbed appearance to one side of the fruit The specimen is not unlike many that are of frequent occurrence on modern plants of *Arctostaphylos pungens* of the inner south coast ranges

Arctostaphylos pungens is a species of the arid hills bordering on the upper part of the Sonoran and the lower part of the Transition zones from central California southward Its precise range cannot at present be stated because it is obvious that what has been going under the name of *A pungens* in current floras of the region is not the same as the plant originally described under that name from the vicinity of Mexico City Furthermore, there is considerable confusion about the taxonomy of the group locally and until this problem can be straightened out by a monographer of the genus as a whole the precise name must stand in abeyance It is possible that *A montana* Eastwood and *A Hookeri* Don may be involved in relationship here to such an extent as to involve the nomenclature of the fossils At any rate, the specimen under consideration is of a type like the modern plants of this group now growing in the inner south coast ranges of California and referred to in modern floras as *A pungens*

University of California Palaeobotanical Collections, Plesiotype no 2814

Echinocystis fabacea Naud

(Plate 24, figs 8, 9)

Echinocystis fabacea Naud Ann. Sci Nat ser IV, 12 154, 1859

Fragments of the seed coat of this species preserved in this deposit differ in no way from the modern species that is so widespread in the inner and outer coast ranges of California Identification was based upon the histological nature of the seed coat, where there are two very different layers of cells evident, an inner layer composed of narrow cylindrical cells and an outer layer about three times as thick composed of many irregularly rounded cells

The inner face of the seed coat is lined with a very soft spongy tissue that readily sloughs off *Echinocystis fabacea* ranges throughout the inner and outer coast ranges of central California, crossing the Tehachapi Mountains to the Mojave Desert, where it has been reported in the vicinity of Muroc. It is not common in the Sierra Nevada foothills, but is abundant in the inner south coast ranges

University of California Palaeobotanical Collections, Plesiotype no 2815

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EXPLANATION OF PLATES

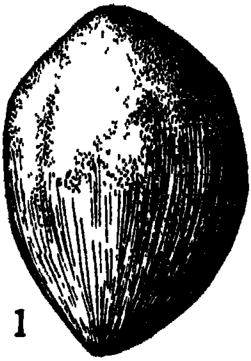
PLATE 23

Gymnosperms in the McKittrick Flora

Fig 1 *Juniperus californica* Carr , drawing of the fossil, × 6. Univ. Calif Palaeobot Coll , Plesiotype no. 2811

Fig 2 Seed of a modern plant of *Juniperus californica* Carr , × 1

Fig 3 Cone of *Pinus monophylla* Torr × 1 Univ Calif Palaeobot Coll , Plesiotype no 2810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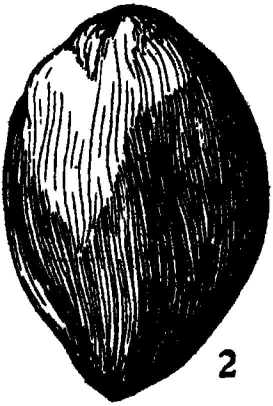
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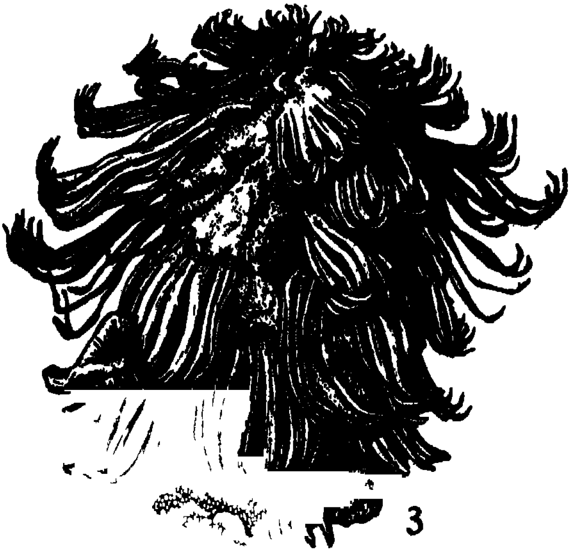
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PLATE 24

Angiosperms in the McKittrick Flora

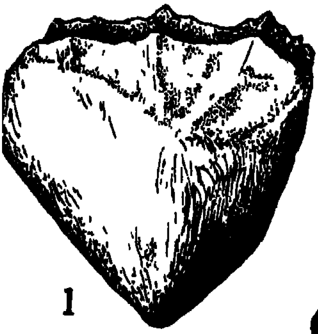
Figs 1, 2, 3 *Atriplex lentiformis* (Torr) Wats. Fruiting bracts, × 10 Univ. Calif Palaeobot Coll , Plesiotype no. 2812

Figs. 4, 5, 6 *Arctostaphylos glauca* Lindl Fragments of fruit Figs. 4 and 5, × 4 , fig. 6, × 5 Univ Calif Palaeobot Coll., Plesiotype no 2813

Fig 7 *Arctostaphylos pungens* H B K Endocarp of fruit, × 8 Univ Calif. Palaeobot Coll , Plesiotype no 2814

Fig 8 *Echinocystis fabacea* Naud Cross section of the seed coat of a modern specimen showing the two layers of the seed coat, × 15

Fig 9 *Echinocystis fabacea* Naud. Cross section of the seed coat of the fossil, × 15. Univ Calif Palaeobot Coll , Plesiotype no 2815



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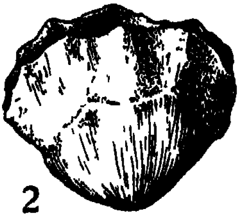

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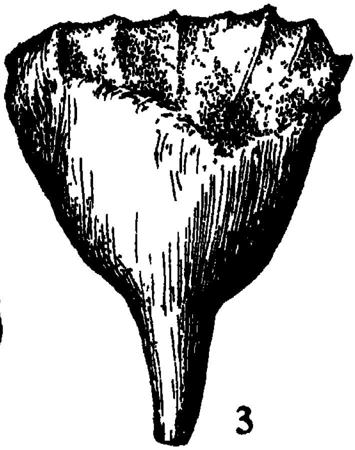

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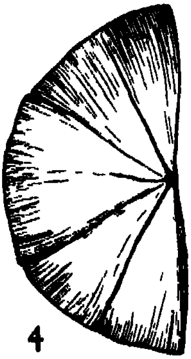

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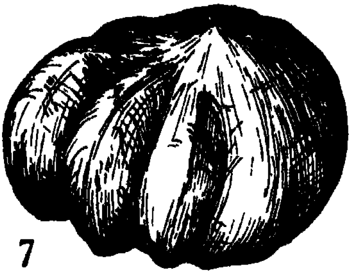

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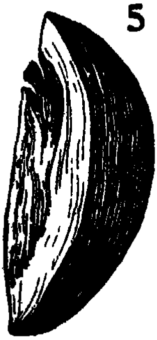

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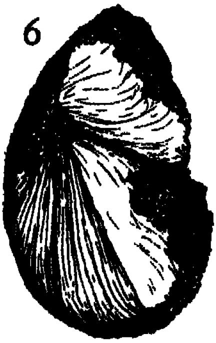

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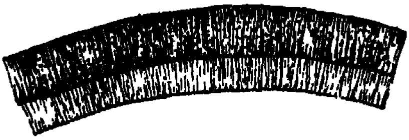

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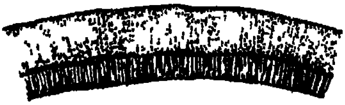

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ALICE EASTWOOD
SEMI-CENTENNIAL PUBLICATIONS

No. 9

THE PERENNIAL SOUTHWESTERN DATURA AND THE VALIDITY OF MATTHEW'S HYPOTHESIS IN PLANT GEOGRAPHY

BY

JOSEPH EWAN
Instructor in Biology, Curator of Botany, University of Colorado

Evidences of phylogeny among major plant groups rest upon two lines of observational research, viz , comparative morphology and paleobotany, and upon two methods of experimental research, viz , serum diagnosis and cytogenetics Among species within a single genus evidences of phylogeny rest again upon comparative morphology in the broadest sense, along with breeding experiments and cytogenetics, with either supporting evidence or the lack of it from the fields of ecology and plant geography Interpretation of morphology is thrown into sharper perspective by subjecting the data to Haeckel's Biogenetic Law, Dollo's Law of Irreversibility, Darwin's evolutionary theory, Liebig's Law of the Minimum as applied to distribution problems, Good's Theory of specific tolerance, Jordan's Law of Geminate Species, Eames' concept of "phyletic slides" within plant groups, and what I have chosen to call Matthew's Hypothesis of Peripheral Populations The subject of the present paper is a consideration of Matthew's Hypothesis as it may prove valid in interpreting distribution phenomena in *Datura meteloides* DC

In his now classic paper entitled "Climate and Evolution" (1915) the American vertebrate paleontologist, W D Matthew, presented a working hypothesis for the evolution of the higher vertebrates He devoted three paragraphs in the beginning to his "Principles of Dispersal," with which we are chiefly concerned. His evolutionary theory embraced the concept that the evolution of land life has responded in adaptation to recurrent periods of aridity through geologic time. In short, Matthew demonstrated that the major advances of vertebrate evolution have coincided with shifts in megaclimates, especially those shifts toward increasing aridity It is a significant corollary of Matthew's Hypothesis, in my opinion, that the angiosperms of arid and semi-arid regions exhibit conspicuous evolutionary advance in their morphology over their relatives of mesic regions.

MATTHEW'S HYPOTHESIS

Matthew's Hypothesis holds that,

> *at any one time in the evolution of a taxonomic group the most advanced stages should be nearest the center of dispersal, the most conservative stages farthest from it*

Or, to use the words of another vertebrate paleontologist, Prof R S Lull, it may be stated that,

> "the most ancient members of a group are not to be found at the old center of evolution, but rather at the periphery of their migratory area." (Lull in George A. Baitsell, ed, Evolution of Earth and Man, pp. 118–119 1929)

In his original paper Matthew points out that the evolution of a race "should be at first most progressive at its point of original dispersal, and it will continue this progress at that point in response to whatever stimulus originally caused it and spread out in successive waves of migration, each wave a stage higher than the previous one" (1915, 180) Assuming that a species is the product, in part, of its environment, and that environments are subject to change, "it is the environment itself, biotic as well as physical, that migrates, and primitive species are those which have followed it, while those which remained have had to adapt themselves to a new environment and become altered thereby " However, it should be remembered that probably "it is never the case that the environment of the marginal species is an absolute replica of the older environment of the race" (1915, 180–181).

The American plant ecologist Stanley Cain expressed the concept in 1940 as follows "in wide-ranging species populations mere distance constitutes a type of isolation and marginal or other portions of a population are frequently recognizable without the development of any conspicuous discontinuity" (1940, 214) Cain points out, furthermore, that these marginal populations are genetically more homozygous In the instance of *Datura meteloides,* the native solanaceous perennial known by the Indian name "tolguacha," this homozygosity may be demonstrated by the occurrence of distinctive leaf types of representative individuals from geographically marginal populations, as recorded in some of the larger herbaria

MATERIALS AND PROCEDURE

This study of *Datura meteloides,* it should be pointed out at the outset, is based wholly upon herbarium specimens and is subject to confirmation from an even more statistical approach, especially in the field over the extensive geographic range of the species, in the manner of Fassett's "mass collection" studies (1941) It may be of interest to record how this problem arose. DeCandolle's original description of *Datura meteloides* rests, not upon the usual preserved herbarium "type" specimen but upon a Sesse and Mociño drawing, rather unfortunate for having been hastily copied from the original The plant from which the drawing was made was collected at an unrecorded locality in, probably, central Mexico by Mociño By comparing this drawing with modern herbarium collections as to close similarity of leaf blade outline an attempt was made to fix, in a general way at least, the possible geographic source, that is, a putative "type locality," of the material which served as the basis of what must be considered, in lieu of an actual preserved plant, the type of the species The taxonomic history of this plant, and certain problems in the systematics of it, are treated elsewhere by the present author (1944)

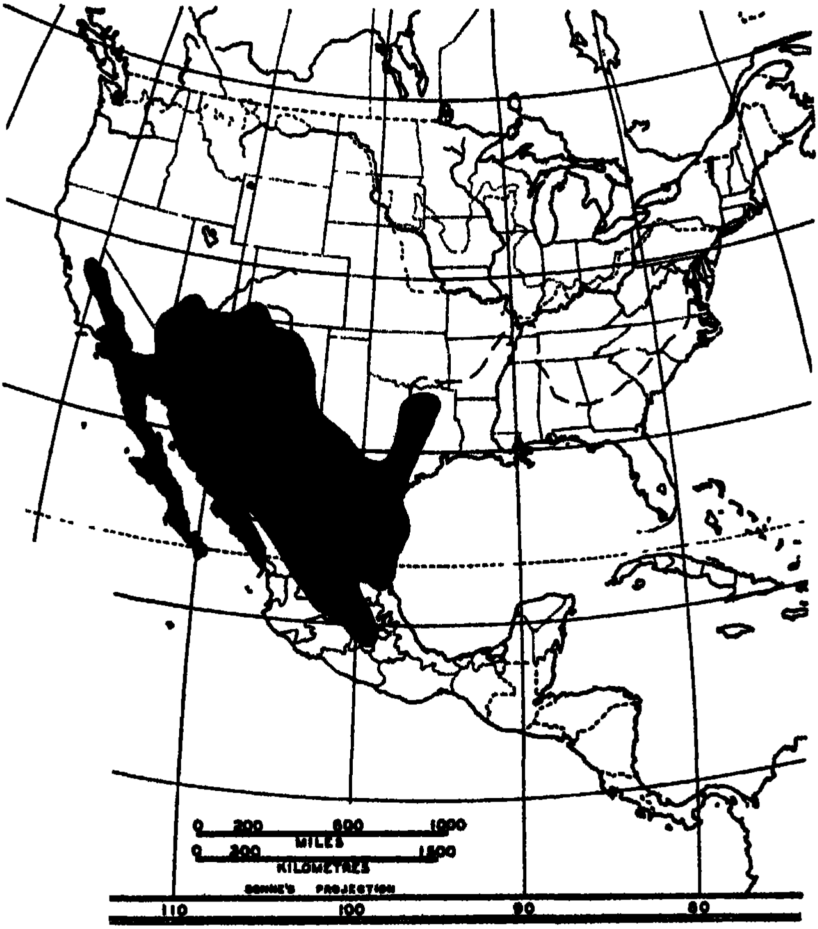

Fig 1 Maximum natural range (generalized) of *Datura meteloides* DC

This paper, then, arose from an examination of nearly 300 collections, primarily from two large herbaria, the U S National Herbarium, and the Rocky Mountain Herbarium of the University of Wyoming, with subsequent examinations of materials in the herbaria of the Academy of Natural Sciences at Philadelphia and the Field Museum To the curators of these collections I am grateful for the privilege of studying the materials in their charge The collections were sorted according to closeness of fit in leaf blade configuration Four chief repetitions in leaf-form were encountered These characteristic infraspecific variations in leaf-form—including equilateral and inequilateral, serrate and subentire forms—were then plotted on outline maps according to the place of collection as recorded on the herbarium labels of each Mature leaves were chosen from each sheet and tracings were made of representative collections Almost invariably the collections were of flowering specimens, and the leaves, therefore, associated with flowering shoots It was found that those collections showing closely comparable leaf-forms came, for the most part, from geographically limital localities These data are given below The total range of the species is shown in a generalized way by the accompanying map (fig 1)

Data from *Datura meteloides*

Four distinctive groups showing close repetition of leaf-form are listed below From each group representative collections are cited, chosen from widely separated and geographically peripheral localities Pen line tracings and map positions are given for each collection

Group One (fig 2)

Leaf form	*Locality*	*Collector*	*Herb and sheet no*
inequilateral ovate and subentire	1. San Bernardino, Calif	G R Vasey 443	USNH 156906
	2 Santa Barbara, Calif	W H Brewer 310	USNH 322527
	3 St George, Utah	M E Jones 6093	RM 14182
	4 Valencia Beach, L Calif	Wiggins and Gillespie 3948	USNH 1491044

Group Two (fig 3)

Leaf form	*Locality*	*Collector*	*Herb and sheet no*
equilateral ovate and serrate	5 Holbrook, Ariz.	Osterhout 6767	RM 169488
	6 Tarrant Co , Texas	A Ruth 583	USNH 1523537
	7 Fuerte, Sinaloa, Mex	Rose, Standley and Russell 13452	USNH 636275

Group Three (fig 4)

Leaf form	*Locality*	*Collector*	*Herb and sheet no*
equilateral ovate and subentire	8 Santa Ysabel, Calif	Henshaw 68	USNH 238095
	9 Colonia Diaz, Chih , Mex	E W Nelson 6430	USNH 360146
	10 Buckskin Mts , Ariz	Jones 6063n	USNH 260638

Group Four (fig 5)

Leaf form	*Locality*	*Collector*	*Herb and sheet no*
equilateral deltoid and serrate	11. Montezuma Co , Colo	Crandall in 1895	USNH 963190
	12 Pasadena, Calif.	G B Grant 270	RM 54824
	13 Mazatlan, Sinaloa, Mex.	Ortega 5654	USNH 1208683

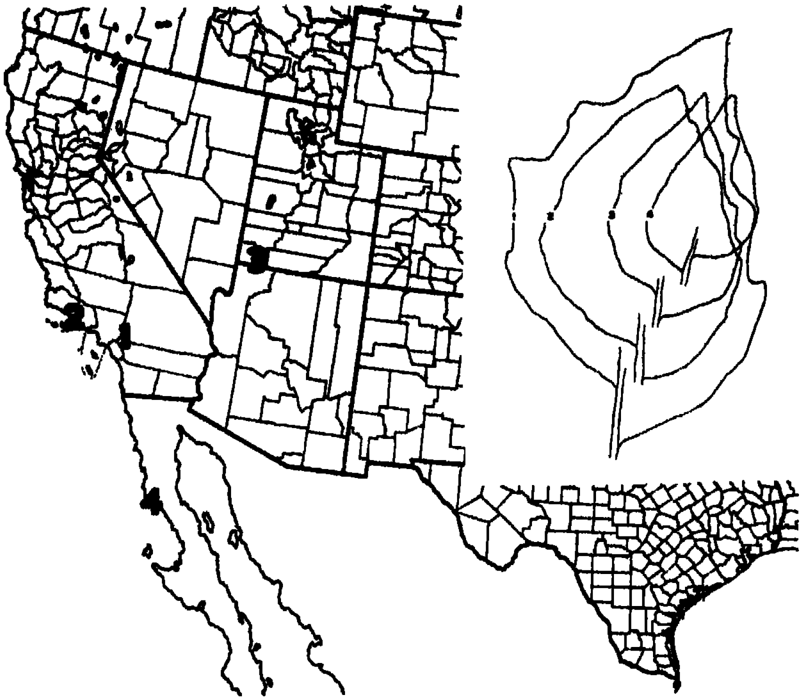

Fig 2 Group One of *Datura meteloides* leaf-forms

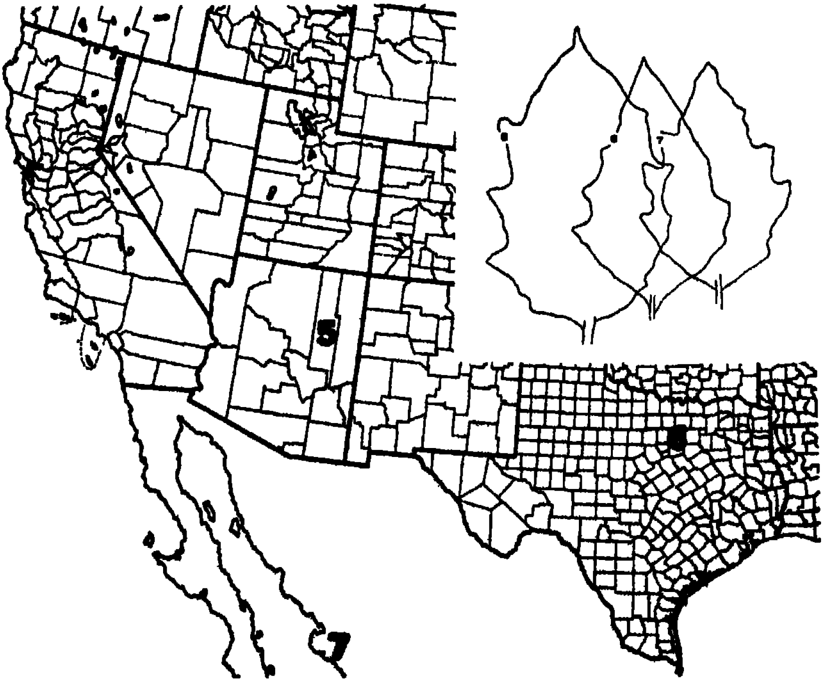

Fig. 3 Group Two of *Datura meteloides* leaf forms.

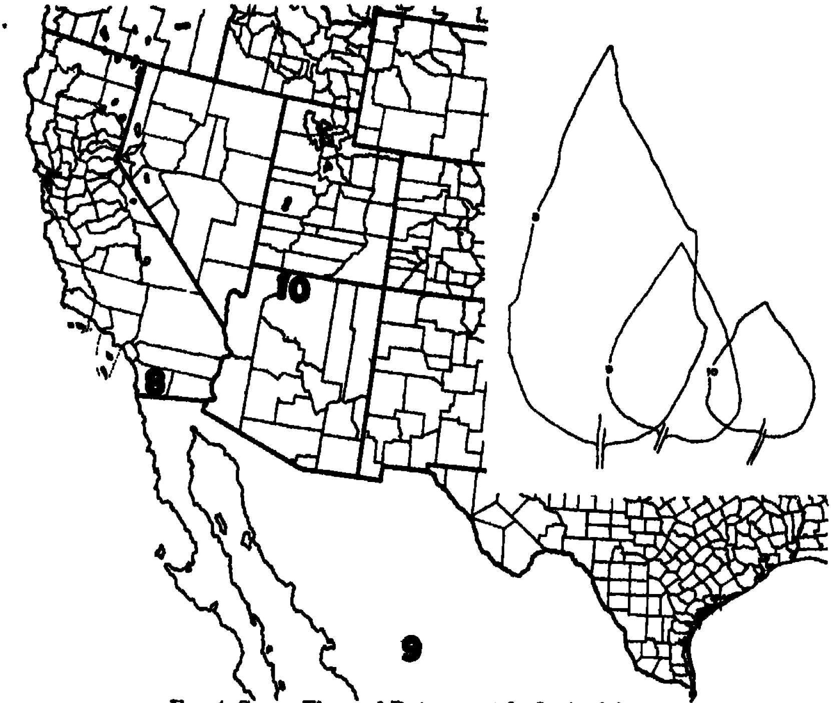

Fig 4 Group Three of *Datura meteloides* leaf forms

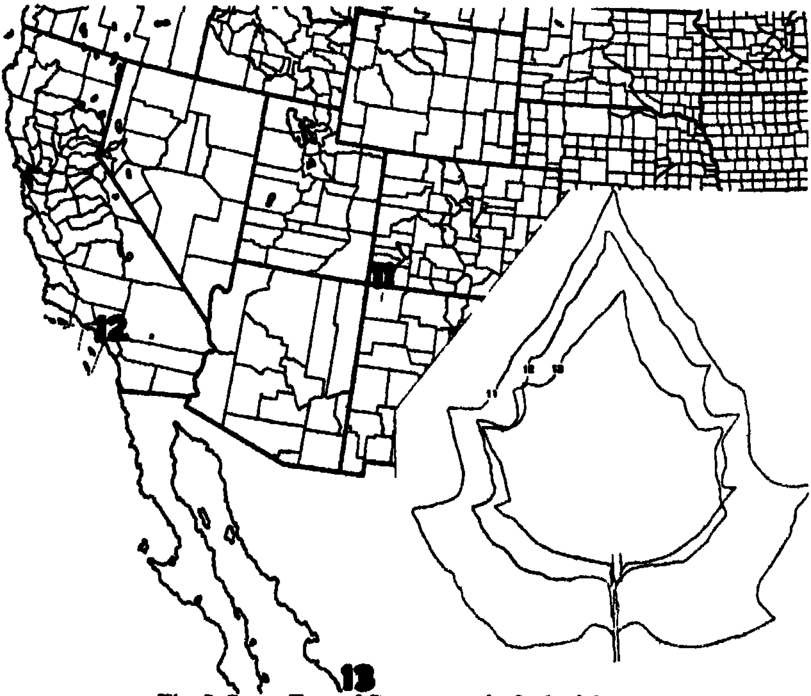

Fig 5 Group Four of *Datura meteloides* leaf forms.

Collections from the more central portion of the range of *Datura meteloides* show a range of leaf-forms well represented by the five tracings made from *Charles Wright 526* from Turkey Creek, Texas, which is the lectotype of *Datura Wrightii* Regel (USNH 60043, cf fig 6, tracings 14–18 inc all from same coll) Collections closely comparable to *Wright 526* in the range of variation of leaf-forms have been made at the stations indicated by the circles in fig 6 This, then, represents the biologic center of the species Doubtless the species will be found to be present, in suitable river bottom and alluvial habitats, in northern Mexico as well, where the map suggests its absence

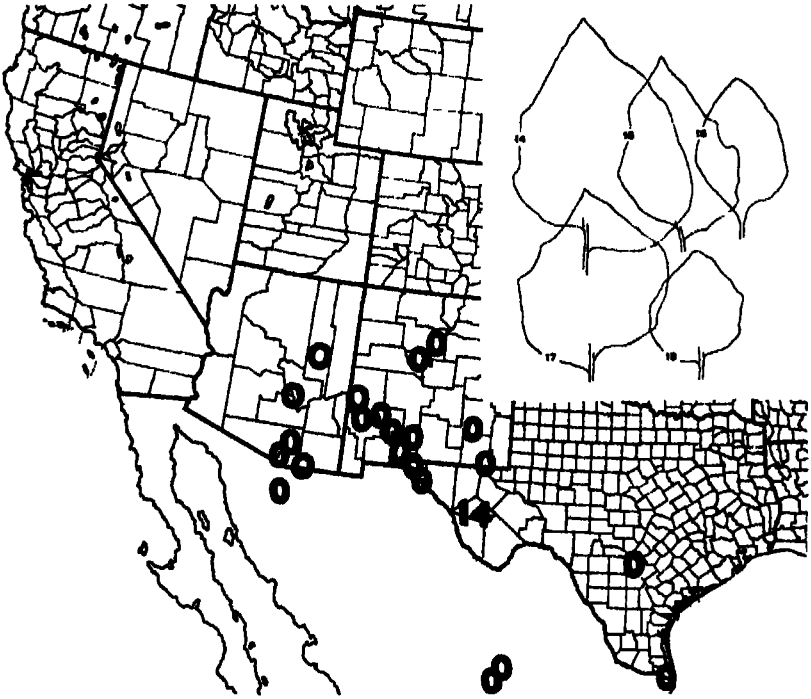

Fig 6 Center of distribution of *Datura meteloides* as determined by conformity in leaf form, with five leaves (nos 14–18) from single coll (*Wright 526*) from locality at "14"

Discussion

The center of distribution for *Datura meteloides* may be recognized as the Rio Grande catchment basin of New Mexico westward to the upper Gila River basin of Arizona This conclusion is based upon a noticeable homogeneity in the populations as demonstrated by the limited range of variation of their leaf-forms The peripheral populations are considered, therefore, to represent fragmentary remnants of the original species colony persistent today as a fringe about the now altered population mass comprising the present "center of distribution"

Gleason noted the agreement of marginal members of a group about a center of distribution in his study of the genus Vernonia. He wrote, "that those species most nearly alike morphologically are always distributed about the same center" (1906, 152) C H Muller found Matthew's Hypothesis to obtain in certain species of Mexican *Quercus* (oral communication, cf also *Am. Midl Nat* 18 844, 1937) In my studies of the Californian flora instances which apparently corroborate Matthew's Hypothesis have been noticed in *Monardella lanceolata* Gray, where small capitulae of closely comparable form and size are to be noticed in plants of Yosemite Valley on the north and San Diego County, California, on the south In the mariposa called "lantern-of-the-fairies," *Calochortus albus* Dougl, closely parallel small-flowered forms may be recognized at almost the same geographically distant localities as in *Monardella*;[1] each an extreme limital population of the species range Among the North American *Delphiniums*, infraspecific phases have been detected in the Californian *Delphinium Parryi* Gray where small-flowered populations occur, again, at limital positions over the total range of the species In *Delphinium patens Greenei* (Eastw) Ewan, a very restricted subspecies of California, plants with identical glandular pedicels occur on Marysville Buttes in the northern Great Valley on the north and from Fresno County upper foothills on the south, with non-glandular plants of *Delphinium patens patens* occupying the intervening area

An apparent antithesis of Matthew's Hypothesis as valid for *Datura meteloides* occurs in *Tradescantia* where the peripheral populations have been demonstrated by Anderson and Woodson (1935) to be derivitive tetraploid infraspecific races, with the ancestral diploid races occupying the center of distribution These infraspecific races are indistinguishable in their morphology The oldest members of the species populations are central, then, and not, as in *Datura meteloides*, marginal to the mass of the species In *Tradescantia* the center of distribution significantly is geologically an old land mass within the total range of the species In *Datura meteloides* the peripheral populations occupy extremely diverse regions which are not often cognate geologically Furthermore, these peripheral populations are not morphologically homogeneous, at least as to their leaf-forms, but differ within themselves from the much more uniform plants of the center of distribution There are, in fact, four distinctive leaf-forms existing more or less side by side within this marginal population, at least in coastal Southern California three of the four leaf-forms occur together.

In the European crucifer *Biscutella laevigata* L. three polyploid infraspecific races—a diploid, tetraploid and hexaploid race—have been shown to exist by Irene Manton (1937) Here the archaic diploids are "xerothermal" interglacial relicts along the river valleys of central Europe from Germany to the Balkans, north and east of the Alps The tetraploid plants occupy the

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[1] "As is frequently the case with *Labiatae*, the extreme forms geographically are often most similar, at least superficially" (Epling, A Revision of *Salvia*. Subgenus *Calosphace*, 191, 1939)

Swiss and Austrian Alps, swept over by glaciers, as a subsequent invading population Obviously there is no direct relation to glaciation in the distribution of *Datura meteloides*

There is, however, with this *Datura* a clear floristic affinity to the Sierra Madrean element of Southwestern United States and Mexico Axelrod's map (1939, 59, fig 2B) should be studied in this regard This map shows the "supposed distribution of the Sierra Madrean element as a dominant" at Lower Pliocene time This extent agrees very closely with the extreme geographic range enjoyed by *Datura meteloides* at the present time Indeed, the peripheral populations whose leaves exhibit these four distinctive leaf-forms characterized in the present paper fall very nearly upon the margin of this mapping of the Sierra Madrean floristic element by Axelrod The only notable exception is the northeastern arm in its range lying to the east of the Llano Estacado of Texas (cf fig 1) This arm falls, perhaps significantly, to the east or coastward of the Fall Line, passing northward on the Coastal Plain sediments The absence of *Datura meteloides* in the region to the west, that is, on the Llano Estacado, is believed by Prof E L Reed to be due essentially to the lack of proper alluvial or river-bottom habitats in that region (personal communication, 22 Feb 1939)[8] The occupation of the Coastal Plain, and hence, the significance of the Fall Line as marking the upper limit of the Coastal Plain or the "boundary between Triassic and older formations on the inland and Lower Cretaceous (Comanchean) and later formations coastward," has been discussed by Pennell very fully (1935, 572–579)

It will be noted that the marginal phases of *Datura meteloides* today are usually topographically isolated by mountain ranges of varying height and extent or by arid desert expanses with their playas and bolsons, serving as topographic barriers Topographic isolation, to a degree then, has maintained these distinctive leaf-forms at these limital stations

SUMMARY

The central populations of *Datura meteloides*, the "tolguacha," though variable, are uniform to a degree and show in general an absence of such leaf-forms as are exhibited by the geographically peripheral populations There exist on the margin of its range today four leaf-forms, these leaf-form types are not geographically segregated, however, but sometimes occur together in the same marginal locality

An explanation may be the population of the original center of distribution was highly heterozygous and consisted of several infraspecific races (this needs cytogenetic confirmation) Applying the concept of Matthew, these several races moved outward in irregular waves of varying intensity and direction and for varying time durations This movement may have been part of the larger general spread of the Sierra Madrean floristic element over the Southwest The end result is a series of partial-populations now scattered on the periphery of the species range Each partial-population is reminiscent in its leaf architecture of its descent from a parent race which, as a race, has been lost in the center of the species mass by the subsequent swamping and intermingling of races and the genetic stabilization of the species.

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[8] Prof B C Tharp finds no coll from the Llano Estacado in Univ Texas Herb

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No. 10

A REVISION OF SOME ARIZONA CACTACEAE

BY

LYMAN BENSON
Associate Professor of Botany
Pomona College

The cactaceae, like other succulent groups, are frequently neglected because of the common impression that specimens are impossible to prepare or are not worth much after they are made It is hoped that recently published articles at least have helped to dispel this notion (Benson, 1939, Peebles, 1942) Mr Peebles has given a particularly thorough account of preparation of cactus specimens, and it is illustrated with excellent photographs Lack of adequate series of herbarium specimens tends to place the burden of study of the Cactaceae upon examination of living individuals in the field Despite the many advantages of this procedure and its absolute necessity, it is impossible to make adequate comparisons from individual to individual without intervening lapse of time, and it is difficult for one person to visit all of the localities in which a particular species is to be found

When "The Cacti of Arizona" was published (Benson *et al*, 1940), the writer was impressed by the close relationship of a number of described species, but evidence of intergradation was not available in the plants examined in the field or in the inadequate herbarium material Continued study in the field and preparation and acquisition of additional herbarium specimens have resulted in the following rearrangement of species, particularly in the genus *Echinocereus.*

Symbols for herbaria in which specimens are deposited are as follows · *Sac*, U. S Field Station, Sacaton, Arizona, *UA*, University of Arizona, Tucson, *B*, Herbarium of Lyman Benson, Pomona College, Claremont, California, *Mo*, Missouri Botanical Garden, St Louis, Missouri, *US*, United States National Herbarium, Smithsonian Institution, Washington, D C; *NY*, New York Botanical Garden, New York City, *S*, Dudley Herbarium, Stanford University, California, *Mich*, University of Michigan, Ann Arbor. A few of these specimens have been examined only in figures or photographs. The herbarium of the writer is now a part of the Pomona College Herbarium.

The vegetation types referred to are as follows (cf Benson, 1942, Shreve, 1936, 1942, Shantz and Zon, 1924)

- Circumboreal Flora
  - Rocky Mountain Forests (spruce fir and yellow pine)
- Eastern Forest Flora
- Sierra Madrean Flora
  - Southwestern Oak Woodland and Chaparral
  - Southwestern Coniferous Woodland (juniper pinyon)
  - Northern Desert (sagebrush)
- Central Prairie Flora
  - Short Grass Prairie (Great Plains grassland)
  - Desert Grassland
- Mexican Desert Flora (creosote bush)
  - Mojavean Desert
  - Sonoran Desert
  - Chihuahuan Desert

OPUNTIA

Opuntia acanthocarpa Engelm and Bigel

Opuntia acanthocarpa ENGELM and BIGEL, 1856, Pac R. R Rept, 4 51, pl 18, f 1–3

Typically an erect, arborescent shrub 1–2 m high but sometimes lower or even sprawling, main trunk very short, usually less than one-fifth the height of the plant, the crown of long branches not dense, branches cylindrical, the joints 1 5–3 dm long or longer, mostly about 2–3 cm in diameter, the surface bearing areoles about 18–30 mm long and about 6 mm broad, laterally compressed, spines about 10–12 at an areole, the larger ones 2 5–3 7 cm long, rather dense on the branches and more or less obscuring the surface of the stem, straw-colored, the sheaths conspicuous and persistent, glochids minute, petals remarkably variable in color, most frequently red or yellow, the flower 2 5–3 7 cm in diameter, fruit dry and more or less shrivelled at maturity, spiny, not giving rise to flowers at the areoles (not proliferous) and not persistent

Abundant on sandy flats and in washes in the Mojavean and Sonoran Deserts at 2,000 to 4,000 feet elevation California in the southern and eastern parts of the Mojave Desert and in the western part of the Colorado Desert, southern Nevada, southwestern Utah, Arizona from western Mohave County and northern Yuma County to the Verde River and the Tucson Mountains and southward to Sonora

Type collection "On the mountains of Cactus Pass, about 500 miles west of Santa Fé" *Bigelow, Mo*

Opuntia acanthocarpa var **Thornberi** (Thornber and Bonker) L Benson, comb nov

Opuntia Thornberi Thornber and Bonker, 1932, Fantastic Clan, 133, 148, pl opposite 134, upper fig

Bushy cholla occurring in patches 1 m or more in diameter, joints of the main stem 4 dm or more in length, tubercles 3–5 cm long, about 6 mm broad and 6 mm high; spines 7–10, *not forming a dense mass on the stem, much less conspicuous than the surface of the stem*, 1 5–2 2 cm long

Gravelly soil of washes, flats, and alluvial fans in the Mojavean and Sonoran deserts at 1,500 to 3,500 feet elevation Peach Springs, Mohave County, and southeastward along the edge of the desert below the Mogollon Rim to northwestern Graham County and northeastern Pima County Many of the plants occurring within a 10 mile radius of Hillside, Yavapai County, are intermediate between this and the typical variety

Type collection "*Opuntia Thornberi* has been described only very recently " There is no evidence of description elsewhere No type is given, but fortunately the line drawing is excellent

Opuntia Stanlyi Engelm

Opuntia Stanlyi Engelm in Emory, 1848, Notes Mil, Recon p 157
Corynopuntia Stanlyi F M Knuth in Backeb and Knuth, 1935, Kaktus ABC, p 114

Low-growing cholla consisting of a clump of short, erect or ascending branches 1–3 dm high, the clumps often 3–7 m in diameter, joints narrowed below, 1–2 dm long, usually 3–5 cm in diameter, the surface bearing conspicuous, mammillate tubercules about 2 5–4 cm long, 6–12 mm broad, and about 6–8 mm high or in an extreme form 12–18 mm high, not tending to join one another or to form ridges along the joint, spines 10–18, those of a single areole 1 3–5 cm long, the larger ones commonly 1–1 5 mm broad, but sometimes 2–3 mm broad, tan or brownish or sometimes red, strongly flattened, sheaths wanting or rudimentary and adherent to the tip of the spine, papillate-roughened, glochids large, petals yellow, the flower about 2 5–3 cm in diameter, fruit markedly spiny, yellow

Rocky or sandy mesas or arroyo banks in the Sonoran Desert at 2,500 to 5,000 feet elevation Arizona on the San Pedro River above Winkleman and from the eastern edge of Aravaipa Valley to the upper Gila River Valley and Clifton, Duncan, and the San Simon Valley (Graham, Greenlee, and Cochise counties); New Mexico on the Gila River

Type collection: "October 22d, 1846 Abundant on the Del Norte and Gila " Type not preserved. On page 63, the location of the camp of Oct 22, 1846, is given as Lat 32° 38′ 13″, Long. 109° 07′ 30″ This is just south of the Gila River on the boundary between the present states of Arizona and New Mexico

Opuntia Stanlyi var **Kunzei** (Rose) L Benson, comb nov.

Opuntia Kunzei Rose, 1908, Smiths. Misc. Coll., 50 505

Joints narrowed below, 7 5–15 cm long, 2 5–3 5 cm in diameter, tubercles distinct, about 1 5–2 5 cm long, narrower and lower than in the typical variety, fruit (as far as known to the writer) 3 3–5 cm long, 12–14 mm. in diameter

Plains at 1,000 to 2,000 feet elevation Maricopa Mountains to Casa Grande and southwestward to the Gunsight Mountains and southward to Baboquivari Valley Perhaps occurring in Sonora

Type collection Pima County, Arizona, *Dr R E Kunze*

Opuntia Stanlyi var **Wrightiana** (Baxter) L Benson, comb nov

Grusonia Wrightiana Baxter, 1935, Calif Cactus, p 58
Opuntia Wrightiana Peebles, 1937, Desert Plant Life, 9 43

Joints nearly cylindrical, 1–1 5 or 2 dm long, 2 5–3 5 or 4 cm in diameter, tubercles tending to be confluent into ribs on the stem, 12–18 mm long, 3–4 mm broad, 3–5 mm high, fruit 3 3–5 cm long, about 12–14 mm in diameter

Sand and clay soils of valley floors in the Sonoran Desert at 300 to 1,500 feet elevation, restricted to regions of 1–5 inches of annual rainfall Southeastern edge of California, Arizona from Detrital Valley, Mohave County, to Yuma County and the western edge of Pima County, southward as far as St George's Bay, Sonora

Type collection "Type Specimen Three joints, one with fruit, collected by Allan B Clayton, April 15, 1934, and deposited in the Dudley Herbarium of Stanford University Type Locality Petrified forest near the Colorado River, four miles west of the Quartzite–Yuma road, 43 miles north of Yuma, Arizona"

Opuntia erinacea Engelm and Bigel

Opuntia erinacea Engelm and Bigel, 1856, Pac R. R. Rept., 4 47, pl 13 f 8–11

Low-growing prickly pear forming clumps 0 3–1 m in diameter, commonly 1–1 5 dm high, the stems usually 2–4 jointed, joints ovate to elliptic-oblong or oblong, flat, 5–15 or 20 cm long, 5–7 5 cm broad, glabrous, areoles usually about 8–10 mm apart, all spine-bearing, spines 4–7 or 9, the longer ones about 5 cm long, more or less stiff, somewhat flattened, elliptic in cross section, white or pale gray, glochids 1 5–3 mm long, petals yellow, white, deep pink, or red, the flower about 5–6 cm in diameter, fruit dry at maturity, more or less cylindrical, about 3 cm long, 12–14 mm in diameter, spiny

Alluvial areas in the Mojavean Desert at 1,500 to 3,000 feet elevation California in the southeastern Mojave Desert, southern Nevada, southwestern Utah, northwestern Arizona in Mohave County, Havasupai Canyon, Coconino County, near Carrizo, Apache County

Type collection "West of the great Colorado near the Mojave Creek" *Bigelow* in 1853–4, *Mo*

Opuntia erinacea var **ursina** (Weber) Parish

Opuntia ursina Weber in Boiss , 1898, Dict Hort , 2 896.
Opuntia erinacea var *ursina* Parish in Jepson, 1936, Fl. Calif , 2 542

Similar to the typical variety, joints obovate to oblong, 1–2 cm long, 6–7 5 cm. broad; areoles all spine-bearing, spines usually 6–14, the longer ones remarkably flexible and thread-like, white or pale gray, not deflexed

Rocky mountain slopes in the Mojavean Desert at 2,000 to 3,000 feet elevation California in the southeastern part of the Mojave Desert, Arizona at scattered stations in Mohave County

Type collection Ord Mountains, southern Mojave Desert in San Bernardino County, California.

Opuntia erinacea var **hystricina** (Engelm and Bigel) L Benson comb nov

Opuntia hystricina Engelm and Bigel., 1856, Pac R R Rept , 4 44, pl 15 f 5–6

Joints obovate, 5–10 or 15 cm long, 3 7–7 5 or 9 cm broad, areoles all or all but the lowest spine-bearing, spines 4 or usually 5–8, the longest ones 4 5–7 5 or 10 cm long, tending to be rigid, deflexed, petals red or yellow

Plains and mountains in the Southwestern Coniferous Woodland, the Short Grass Prairie, and the Rocky Mountain Forests at 4,500 to 7,000 feet elevation. Northern Arizona from Coconino County to Apache County, northern New Mexico Flowering in June

Type collection " Abundant from the Rio Grande westward to the San Francisco mountains, .. The specimens before us were obtained at the Colorado Chiquito and on the San Francisco Mountains." *Bigelow* in 1853–4, *Mo*

Opuntia erinacea var **rhodantha** (K Schum) L Benson, comb nov

Opuntia rhodantha K Schum , 1897, La Semaine Hort , ——— 1898 Gesamtb Kakteen 735

Joints obovate, 5–10 cm long, 3 7–7 5 cm broad, more or less lead-colored (in the other varieties green); usually only the distal areoles of each joint spine-bearing, those on at least the lower half of the joint usually spineless, spines 1–6 or 8, the longer ones 2 5–3 7 cm long, tending to be rigid, deflexed, flowers usually red but sometimes yellow (*e g* McGee Creek, Mono County, California, *L Benson 11212, UA, B*)

Flats and rocky hills in the Southwestern Coniferous Woodland, the Northern Desert, and the Rocky Mountain Forests at 5,000 to 8,000 feet elevation California along the east side of the Sierra Nevada in southern Mono County and Inyo County (Big Trees Camp, Lake Sabrina Road above Bishop, *L. Benson 6009, B*) and eastward to western Nebraska, Arizona from Mt. Dellenbaugh, Mohave County, to Prescott, the Mogollon Rim, the northern end of the White Mountains and northeastward.

Type collection: "Colorado, bei 200—2300 m Höhe PURPUS, blühte bei SPATH im Juni . "

Opuntia compressa (Salisb) Macbr.
Plate 25, fig A, 3

Cactus Opuntia L. 1753, Sp Pl , p 468
Cactus compressus Salisb , 1796, Prodr , p 348
Opuntia compressa Macbr., 1922, Contr Gray Herb , (65) 41
Opuntia vulgaris of authors, not of Mill , 1768

Low, prostrate or nearly prostrate prickly pear, roots fibrous, joints light green, broadly obovate to nearly circular, 4–11 cm long, 4–9 cm broad; leaves 4–5 mm long, more or less appressed, spines none or solitary in the distal areoles, petals pale yellow, the flower about 5 cm in diameter, "with about 8 petals", fruit 2–3 cm long

Dry gravelly or sandy soil in the Eastern Forest Flora at low elevations Southern New England and southward along the Atlantic coastal plain to South Carolina This species is represented westward by varieties, and the Arizona plants of both fibrous-rooted and tuberous-rooted types tentatively are referred to them

Opuntia compressa (Salisb) Macbr. var **microsperma** (Engelm)
L Benson, comb nov

Cactus humifusus Raf , 1820, Ann Nat., p 15
Opuntia humifusa Raf , 1830, Med Fl U S , 2. 247
Opuntia mesacantha Raf , 1830, Bull Bot Seringe, p 216
Opuntia caespitosa Raf , 1830, *loc cit*
Opuntia Rafinesquei Engelm , 1856, Pac R R Rept , 4 41, pl 11 f 1–3
Opuntia Rafinesquei var *microsperma* Engelm , 1856, *loc cit*
Opuntia cymochila Engelm and Bigel., 1856, Pac R R Rept , 4 43, pl 12 f 1–3
Opuntia stenochila Engelm and Bigel , 1856, *loc cit* , p 44, f 4–6
Opuntia mesacantha var *microsperma* Coult , 1896, Contr U S Nat Herb , 3 429
Opuntia nesacantha var *cymochila* Coult , 1896, *loc cit* , p 430
Opuntia mesacantha var *stenochila* Coult , 1896, *loc cit* , p 430.

Roots fibrous, joints dark green, averaging a little larger than in the typical variety, 7–12 cm long, 5–10 cm broad, leaves "6–8" mm long, not appressed, spines mostly 1–3, one much larger than the other (accessory) ones, petals "10–12", fruit 3–4 cm long (*Fig A 3*)

According to Peebles, *apud* Kearney and Peebles, U S Dept Agric Misc Publ , (423) 611, 1942, this plant, designated as *O Rafinesquei,* occurs in northern Arizona from "Apache County to northern Mohave County, not common, 5,000 to 7,000 feet " The writer has seen no Arizona specimens This wide-ranging middle western variety of the eastern *Opuntia compressa* is exceedingly variable. It includes a host of minor forms variously considered as species and varieties, and some may be worthy of segregation as varieties

Type collections (1) *C humifusus,* "From New York to Kentucky and Missouri " (2) *O mesacantha,* Kentucky to Louisiana (3) *O caespitosa,* Kentucky and Tennessee (4) *O Rafinesquei, nom nov* for the first three described species, and antedated by all of them No type designated and only the general range given (5) Var *microsperma* No type designated and the range not distinguished from the broad range of the typical variety (of *O Rafinesquei*) in the Mississippi Valley. (6) *O. cymochila*, called a subspecies, but the name published as a binomial, "On the Camanche plains east of Llaño Estacado, near the 100th degree of longitude, and from there to Tucumcari, 80 miles east of the Pecos" in New Mexico *Bigelow* in 1853–4, *Mo* (7) *E stenochila*, called a subspecies but published as a binomial, "At the Canyon of the Zuñi," *Bigelow* in 1853–4, *Mo*.

Opuntia compressa var **macrorhiza** (Engelm) L Benson, comb. nov

Plate 25, figs A, 1, 2

Opuntia macrorhiza ENGELM, 1850, Bost Jour Nat Hist, 6 206
Opuntia fusiformis ENGELM and BIGEL, 1856, Pac R. R Rept, 4 43
Opuntia mesacantha Raf var *macrorhiza* COULT, 1896, Contr U S Nat Herb, 3 430
Opuntia plumbea ROSE, Smiths Misc Coll, 1908, 50 524
Opuntia delicata ROSE, 1911, Contr U S Nat Herb, 13 310
Opuntia Loomisii PEEBLES, 1938, Cact and Succ. Jour, 9 109

Similar to var *microsperma*, roots tuberous even in young plants, spines commonly 2 or more per areole

Plains and hills in the Desert Grassland, the Southwestern Coniferous Woodland, the Southwestern Oak Woodland, and the Rocky Mountain Forests at 4,500 to 6,000 feet elevation and (eastward) in the Short Grass Prairie and in the Eastern Forest Flora Arizona from Mohave County to Apache County, eastern Pima County, and Santa Cruz County, eastward to Missouri and Texas The Arizona form is variable Usually it is longer-spined and often the joints are larger Some forms approach the fibrous-rooted species, *Opuntia phaeacantha*

Type collections (1) *O macrorhiza*, "Naked, sterile, rocky places on the Upper Guadaloupe" Texas, *Lindheimer, Mo* (2) *O fusiformis*, called a subspecies, but published as a binomial, "Cross timbers longitude 97°–99° " *Bigelow* in 1853–4, *Mo* (3) *O plumbea*, San Carlos Indian Reservation, Arizona, Coville in 1894, *US* This form is apparently identical with that on the Great Plains A specimen (Pearce, Cochise County, *Nichol* in 1940 [pl 25 *fig A, 1*]) is growing in the Pomona College botany greenhouse (4) *O delicata*, "Type U S National Herbarium no 454622, collected by J N Rose at Calabasa, April 30, 1908 (no 11951) " Arizona (5) *O Loomisii*, "Type, *H F Loomis No SF 298*, Prescott, Arizona, Aug 10, 1930, represented by a plant grown under cultivation at Sacaton, Arizona, and material removed from the cultivated plant and deposited in the U S National Herbarium, Washington, D C" This is the extreme opposite the type described by Rose as *O plumbea*, and it approaches *O phaeacantha*

Opuntia tortispina Engelm and Bigel

The plant described previously as *Opuntia tortispina* is merely a form of *Opuntia phaeacantha* with long, twisted, light-colored spines The description was drawn from plants collected four miles south of Navajo Bridge, Coconino County, by A A Nichol in 1940

ECHINOCEREUS

Mostly small cacti forming low clumps 1–4 dm or rarely about 1 m in diameter and rarely more than 3 (maximum 6) dm high or the stems not infrequently solitary, the length of a single branch not more than 8 (or rarely in a decumbent type 12) times the diameter; stem usually branching only at or near the base except after injury, or sometimes unbranched, with continuous ribs, cylindrical or ovoid, leafless even on the new season's growth, areoles not producing glochids, flower appearing below the apex of the branch; the flower bud bursting through the epidermis above the lower edge of a spine-producing areole, floral tube (hypanthium?) long or at least well-developed above the ovary; fruit spiny, the clusters of spines readily removed at maturity.

The plants of this genus occurring in Arizona are members of complex groups Previously (Benson *et al*, 1940) ten described species were recognized as closely related entities, although it was clear that the group was in need of reorganization and that several species might better be reduced to varieties Further study in the field and collection of additional herbarium and garden material emphasizes the need for the following revision The differentiation of this genus from *Cereus* has been discussed in another paper (Benson, 1941)

Key to the Species

1. Petals scarlet or crimson (with plastid pigmentation?), areoles bearing white felt at maturity, flowers not closing at night, remaining open until the end of anthesis
1. *Echinocereus triglochidiatus*

1. Petals purple to lavender (probably pigmented with anthocyans), areoles not bearing white felt at maturity, the felt of the young areoles rarely persistent for two years, flowers closing at night and reopening in the morning or in hot weather withering at the end of a single day

  2 Areoles vertically elongate, stems unbranched 2. *Echinocereus pectinatus*

  2 Areoles circular, stems usually branched except in young plants

    3 Central spines 2–6, approximately the same size or at least all well developed, usually (at least the lower deflexed ones) flattened at least at the bases.
3 *Echinocereus Engelmannii.*

    3 Central spine 1, often with 1–3 shorter accessory or rudimentary centrals in some of the areoles of the plant, circular in cross section, not flattened

      4 Principal central spine not both strongly curved and pointing downward, spines white, gray, red, black, brown, or bicolored; flowers 5–8 5 cm in diameter
4 *Echinocereus Fendleri*

      4 Principal central spine strongly curved near the base, turned downward, spines yellow or straw-color, uniformly colored, flowers (in the specimens available) 3 5–5 cm. in diameter . 5. *Echinocereus Ledingii*

1 **Echinocereus triglochidiatus** Engelm

Echinocereus triglochidiatus Engelm, in Wisliz, 1848, Mem Tour N. Mex., p 93
Cereus triglochidiatus Engelm., *apud* A Gray, 1849, Mem Amer. Acad., II 4 50
Echinocereus paucispinus (Engelm.) Engelm, ex Rümpler var *triglochidiatus* K Schum, 1898, Gesamtb Kakteen, 281

Older plants dense, forming clumps of few to many stems each 2–4 or 6 dm high, mostly 4–8 cm in diameter, obviously and conspicuously green, not obscured by the spines, ribs commonly 5–8, somewhat tuberculate at the areoles, spines exceedingly variable, sometimes as few as 3 or as many as 16, 1–3 cm long, central spines 0–5 or 6, smooth and ribbed, somewhat longer than the radials; radial spines 3–10; areole circular, bearing white felt; petals crimson or scarlet, the flower about 3 cm in diameter, floral tube 2–3 cm long above the ovary, the scales with tufts of white hair, fruit more or less spiny, subcylindrical, about 2–3 cm. long

Southern Colorado to trans-Pecos Texas A few Arizona plants approach the typical variety

Type collection "On Wolf Creek [near Santa Fé, New Mexico], in pine woods, flowers in June [Wislizenius in 1846, *Mo*], Santa Fé (Fendler) .. " *Mo.*

1A **Echinocereus triglochidiatus** var **gonacanthus** (Engelm and Bigel) Engelm and Bigel *ex* W T Marshall

Cereus gonacanthus ENGELM and BIGEL, 1856, Pac R. R Rept., 4. 33, pl. 5 f. 2–3
Echinocereus gonacanthus Engelm., *ex* Rümpler in FÖRSTER, 1885, Handb Cacteenk., ed. 2, p 806
Echinocereus paucispinus (Engelm.) Engelm, *ex* Rümpler var *gonacanthus* K SCHUM, 1898, Gesamtb. Kakteen, p. 281.
Echinocereus triglochidiatus var *gonacanthus* (Engelm and Bigel) Engelm and Bigel, *ex* W T. Marshall in MARSHALL and BOCK, 1941, Cactaceae, p 117

A robust type similar to the typical variety, spines mostly 6–8 per areole, twisted and somewhat curved, central spine usually solitary but sometimes more than one, 3–5 cm long, markedly angled with usually 6 or 7 sharp ribs, radial spines 2–3 cm long.

High plains at the lower edge of the Rocky Mountain Forests at 6,000 to 8,000 feet elevation Arizona 40 miles west of Zuñi, New Mexico, and near St. Johns, Apache County, (*Wyatt W Jones*, the specimen with 3-angled central spines) New Mexico near Gallup and Zuñi Reported from the White Sands

Type collection "On high sand bluffs, covered with scattering cedars, near the natural well, about 40 miles west of Zuñi, near the 109th degree Only seen in that locality" Probably Apache County, Arizona, *Bigelow* in 1853–4, *Mo* Zuñi, New Mexico, is within 10 or 12 miles of the Arizona line, but the 109th Meridian is just east of the state boundary

1B. **Echinocereus triglochidiatus** var **polyacanthus** (Engelm) L Benson, comb nov

Echinocereus polyacanthus Engelm. in WISLIZ., 1848, Mem Tour N Mex, p 104.
Cereus polyacanthus Engelm. *apud* A GRAY, 1849, Mem. Amer. Acad, II, 4 50
Echinocereus arizonicus ORCUTT, 1926, Cactography, (3) 3

Clumps of stems not dense or dome-like, the stems usually 15–45, 1.5–5 dm. high, 6–10 cm in diameter, elongated and cylindrical, ribs about 9–10, prominent, not markedly tuberculate at the areoles; central spines 2–4, turned downward or perpendicular to the stem, straight, stout or slender, 2.5–5 cm. long; radial spines about 10, appressed; flower about 3 5–4 cm in diameter; floral tube about 3 cm. long above the ovary

Desert Grassland and Southwestern Oak Woodland at 3,500 to 5,500 feet elevation. Arizona in the Pinal Mountains, Pinal County, and the Galiuro

Mountains, Graham County, and southward to Santa Cruz and Cochise counties Southeastern Arizona to western New Mexico, Chihuahua, and Durango Flowering late in May and in June

Type collections· (1) *E polyacanthus*, "Cosihuiriachi," Chihuahua, *Wislizenius* in 1846–7, *Mo* (2) *E arizonicus*, Pinal Mountains, Pinal County, Arizona.

1c **Echinocereus triglochidiatus** var **melanacanthus** (Engelm) L Benson, comb nov

Echinocereus coccineus Engelm in WISLIZ., 1848, Mem Tour N Mex , p 93
Cereus coccineus Engelm *apud* A GRAY, 1849, Mem Amer Acad , II, 4 51 1849, not Salm Dyck *ex* DC in 1828
Cereus coccineus var *melanacanthus* ENGELM , *loc cit*
Cereus coccineus var *cylindricus* ENGELM , *loc cit*
Cereus mojavensis var *zuniensis* ENGELM and BIGEL , 1856, Pac R. R Rept , 4 33, pl 4, f 9
Cereus Bigelovii Engelm var *zuniensis* Engelm , *apud* ENGELM and BIGEL , 1856, *loc cit* (on the plate)
Cereus phoeniceus Engelm *apud* ENGELM and BIGEL., 1856, *loc cit* , p 34 f 1–3
Echinocereus phoeniceus Engelm , *ex* Rümpler in FÖRSTER, 1885, Handb Cacteenk , ed 2, p 788
Echinocereus mojavensis var *zuniensis* Engelm , *ex* Rümpler, FORSTER, 1885, *loc cit* , p 803
Echinocereus phoeniceus var *inermis* K SCHUM , 1896, Monatsschr Kakteenk , 6 150
Echinocereus coccineus var *inermis* J A PURPUS, 1925, Mitt Deutsch Dendr Ges , 1925 49
Echinocereus triglochidiatus var *coccineus* Engelm , *ex* W T Marshall in MARSHALL and BOCK, 1941, Cactaceae, p 117
Echinocereus canyonensis CLOVER and JOTTER, 1941, Bull Torrey Club, 68 417 f 1 (4)

Stems from a few to more than 500, cylindrical or ovoid, 0 7–1 5 dm. high, mostly 3–5 or 6 cm in diameter, ribs commonly 8 or 10, not markedly tuberculate at the areoles, central spine 1 or sometimes more than 1, perpendicular to the joint, straight, tapering, 1 3–3 cm long, radial spines commonly 5–10, similar to the central spine but smaller, flower 3–4 5 cm in diameter, floral tube 2 5–3 cm long above the ovary

Rocky hillsides and the forest floor in the Southwestern Coniferous Woodland, the Southwestern Oak Woodland and Chaparral, and the Rocky Mountain Forests at 4,000 to 8,000 feet elevation Arizona in the mountainous regions from the Hualpai Mountains to the Kaibab Forest, and southeastward to the Santa Catalina Mountains, Pima County, and to Greenlee County, thence southward to Santa Cruz and Cochise counties Southern Utah to Colorado, Arizona, and New Mexico Flowering from March until June, depending upon altitude

Type collections (1.) *E coccineus*, "With the foregoing, also about Santa Fé " The "foregoing" was *E triglochidiatus*, see above. *Mo* (2) Var *melanacanthus*, "Among a number of plants of this family which Mr Fendler sent from Santa Fé in a living state, but which unfortunately were all dead when they came to hand, are some specimens which appear to be varieties of this species . " (3) Var *cylindricus*, cf statement for var *melanacanthus* *Mo* (4) Var *zuniensis*, "It was found near Cañon Diablo, on the Colorado Chiquito, about 120 miles west of Zuñi " Canyon Diablo, near the Little Colorado River, Arizona, *Bigelow* in 1853–4, *Mo* (5) *C phoeniceus, nom nov for E. coccineus* (6) Var.

inermis," Herr C A Purpus aus Colorado an die hiesige berühmte Gartnerei von *SPATH* schickte ." (7) *E. canyonensis,* "TYPE (*Clover and Jotter 2317*) collected in a sandy pocket on a steep limestone outcrop 100 yards from the [Colorado] river, Bass Cable below Hermit Creek Rapids, Grand Canyon, Coconino Co, Arizona Locally abundant Living specimen in the Botanical Gardens, (*Gard 16846*), University of Michigan, Ann Arbor, Michigan " Specimen now pressed.

1D **Echinocereus triglochidiatus** var **mojavensis** (Engelm) L Benson, comb nov

Cereus mojavensis Engelm and Bigel., 1856, Pac R R. Rept., 4 · 33 pl. 4
Cereus Bigelovii Engelm, apud Engelm and Bigel, 1856, *loc cit* (on the plate)
Echinocereus mojavensis Engelm, *ex* Rümpler in Förster, 1885, Handb Cacteenk, ed 2, p 803

Similar to var *melanacanthus;* ribs (of the material available) strongly tuberculate at the areoles, spines curving, tortuous, somewhat flexible, whitish, floral tube (of the plants available) 1 7–2 cm long

Rocky hillsides in the upper Mojavean Desert and the Southwestern Coniferous Woodland at 3,500 to 5,000 feet elevation Arizona in scattered localities in Mohave County (Black Mountains, Grand Wash Cliffs, Hualpai Indian Reservation) Southeastern California to southern Utah and northwestern Arizona

Type collections (1) *C mojavensis,* "Found between the Rio Colorado and Mojave Creek " California east of the Mojave River, *Bigelow* in 1853–4, *Mo* (2) *C Bigelovii,* apparently a discarded name once intended to be proposed for the same plant

2 **Echinocereus pectinatus** (Scheidw) Engelm

Echinocactus pectinatus Scheidw, 1838, Bull Acad Sci, Brux, 5 492
Echinocactus pectiniferus Lemaire, 1839, Cact Gen Nov sp, p 25
Echinopsis pectinata Fennel, 1843, Allg Gartenz, 11 282
Echinocereus pectinatus Engelm, in Wisliz, 1848, Mem Tour N Mex, p 110
Cereus pectinatus Engelm, *apud* A Gray, 1849, Mem Amer Acad Sci, II, 4 50
Cereus pectiniferus Labouret, 1853, Monogr Cact, p 320

Stem unbranched, erect, cylindrical, 1–2 dm high, 3–8 cm in diameter, ribs about 20, not markedly tuberculate at the areoles, but transversely grooved between adjacent areoles, spines white to red, not completely obliterating the stem, central spines 2–5, mostly 3, mostly 1–3 mm long, in a single row, radial spines 15–20, appressed against the stem, pectinate, markedly appressed, 3–8 mm long, flattened, straight, tapering, areoles vertically elongate, the growth of different years marked off by the color of the spines produced in early or late season, flower funnel-form, petals reddish-purple, tending toward lavender, floral tube about 12 mm long above the ovary; fruit nearly spherical, about 2 5 cm. in diameter

Rocky or gravelly hills in the Desert Grassland and perhaps the Southwestern Oak Woodland at 4,000 to 5,000 feet elevation Southeastern Arizona to Chihuahua The plant occurring in Cochise County, Arizona, seems to be referable to the typical variety, but it has not been seen in flower (Perilla Mts., *Harlan* in 1939, *Sac* ; near Douglas, *W W Jones UA, B*; 16 miles northeast of Douglas, *Benson and Darrow 11118, UA, B*) This is one of several Chihuahuan Desert species occurring on limestone hills in southeastern Arizona.

Type collection · The identity of the type is difficult to establish According to Britton and Rose, Cactaceae, 3 29–30, 1922, "This species was first collected by Galeotti who sent a collection to Belgium from the states of San Luis Potosí and Guanajuato, Mexico. The type station, Villa del Pennasco, we have not located It was soon after figured by Lemaire (Icon Cact, pl 14 or 15) and Pfeiffer (Abbild Beschr Cact, 2. pl 10), very likely from the type collection." According to Engelmann, *loc cit*, however, the type is from Chihuahua "The description of the plant (which died without producing flowers) found in several works, as well as in the latest publication on *Cactaceae*, before me, of Foerster, Leipzig, 1846, was made, as Prince Salm informed me, from specimens sent from Chihuahua by Mr Potts It entirely agrees with my specimen from the same region"

2A **Echinocereus pectinatus** var **rigidissimus** (Engelm) Engelm *ex* Rumpler

Cereus pectinatus (Scheidw) Engelm , var *rigidissimus* ENGELM , 1857, Proc Amer Acad , 3 279

Echinocereus rigidissimus ROSE, 1909, Contr. U S Nat Herb , 12 293

Echinocereus dasyacanthus Engelm , var *rigidissimus* W T Marshall in MARSHALL and BOCK, 1941, Cactaceae, p 119

Stems 0 7–3 5 dm high, 5–10 cm in diameter, areoles crowded, the spines completely obliterating the surface of the stem, central spines none, radial spines flat, thicker and stronger than in the typical variety, 15–18, strongly appressed, 6–14 mm long, flowers between lavender and magenta

Occurring on rocky slopes and grassy areas in the Desert Grassland and the Southwestern Oak Woodland at 4,000 to 6,000 feet elevation Arizona from the Baboquivari Mountains to the Santa Catalina Mountains, Pima County, and southeastward to Santa Cruz and Cochise counties; northern Sonora

Type collection " from Sonora " According to Engelmann, in Emory, Rept U S. and Mex Bound Surv., 2 32, 1859 "In the Sierras of Pimeria Alta in Sonora, and farther west (A Schott) Flowers in June and July " *Mo*

2B **Echinocereus pectinatus** var **neomexicanus** (Coulter) L Benson, comb nov

Echinocereus dasyacanthus Engelm , in WISLIZ , 1848, Mem. Tour N. Mex , p 100.

Cereus dasyacanthus Engelm , *apud* A GRAY, 1849, Mem. Amer Acad , II, 4 · 50

Cereus ctenoides Engelm , in EMORY, 1859, Rept U. S and Mex Bound Surv , 2 31, pl 42

Cereus ctenoides Engelm , et Rumpler in FÖRSTER, 1885, Hand. Cacteenk , ed. 2, p. 819, f 109.

Cereus dasyacanthus var. *neomexicanus* COULT , 1896, Contr U S Nat Herb , 3 384.

Not *Echinocereus neomexicanus* STANDL., 1908, Bull. Torrey Club, 35 87

Stems 1–3 dm high, 5–7 or 10 cm in diameter; areoles crowded, the spines usually practically obliterating the surface of the stem, central spines mostly 5–8, usually arranged irregularly (or in a single row in types transitional to the typical variety), 3–10 mm long; radial spines somewhat flattened, 15–20 or more, not markedly appressed, 10–15 mm. long, flowers typically yellow but sometimes varying to the magenta series.

Desert Grassland and Oak Woodland at 4,000 to 5,000 feet elevation. Arizona (according to Professor Thornber) in the southern part of the Baboquivari Mountains, Pima County, and (according to A A. Nichol) in the Perilla and Guadaloupe mountains, Cochise County, as well as (according to A. A. Nichol) in perhaps modified form in the Oro Blanco Mountains west of Nogales, Santa Cruz County, and at Altar and Pitiquito in adjacent Sonora; Southern New Mexico, Trans-Pecos Texas; Chihuahua

Type collections (1) *E dasyacanthus*, "On the mountains near El Paso, in August in flower and fruit" *Wislizenius* in 1846–7, *Mo* (2) *C ctenoides*, "From Eagle Pass to Santa Rosa (Bigelow), on the Pecos (Wright)" Texas. *Mo* (3.) Var *neomexicanus*, "Type, Wright 366 in Herb Mo Bot Gard Southeastern New Mexico" The necessity for use of this name in varietal status is unfortunate, for the little known epithet *neomexicanus* displaces the well known one, *dasyacanthus*, and the epithet *neomexicanus* was proposed later in specific rank for a plant of the *Echinocereus triglochidiatus* complex

3 **Echinocereus Engelmannii** (Parry) Parry *ex* Rümpler

Cereus Engelmannii Parry *ex* ENGELM, 1852, Amer. Jour Sci., II, 14 338
Cereus Engelmannii var *variegatus* ENGELM, 1856, Pac R R Rept, 4 35, pl 5 f. 4–7
Cereus Engelmannii var *chrysocentrus* ENGELM., 1856, *loc cit*, f 8–10
Echinocereus Engelmannii (Parry) Parry *ex Rümpler* in FÖRSTER, 1885, Handb Cacteenk., ed 2, p 805
Echinocereus Engelmannii var *variegatus* Engelm, *ex* Rumpler, FÖRSTER, 1885, *loc cit*, p 806
Echinocereus Engelmannii var *chrysocentrus* Engelm, *ex* Rumpler, FÖRSTER, 1885, *loc cit*, p. 806
Echinocereus chrysocentrus ORCUTT, 1926, Cactography, (3) 4

Clumps not dense, stems erect, usually 1–25, not crowded, cylindrical, usually 1 5–3 dm. high, 5–7 5 cm in diameter, firm, ribs usually 10–13, not markedly tuberculate at the areoles, spines sometimes obliterating the surface of the stem, central spines 2–6, all large and well-developed, red, yellow, white, brown, or gray, or the lower one white and the others variously colored, some of them deflexed, tapering, 3 7–9 cm long, stout but somewhat flexible, curving or twisted, usually flattened at the bases, radial spines 6–12, similar to the central but smaller, areole circular or nearly so, not bearing white felt after the first year, petals purple to magenta, the flower 5–7 5 cm in diameter, funnel-form; floral tube about 12 mm long above the ovary, fruit red, nearly spherical to ovoid, about 3 cm long, spiny, shedding the interlocking spines at maturity, edible

Hills, plains, alluvial bottoms, and benches in the Northern, Mojavean, and Sonoran deserts at 100 to 2,500 or rarely 5,000 feet elevation California about the Owens River Valley and in the Mojave and Colorado deserts, southern Nevada, southern Utah; Arizona from southern Mohave County to Yuma County, Pinal County, and western Pima County, Baja California to Sonora. Flowering in late March and in April.

Type collections: (1) *C. Engelmannii*, "Mountains about San Felipe, on the eastern declivity of the Cordilleras." Colorado Desert in San Diego County, California, *Parry* in

1852, *Mo* (2) Var *variegatus*, "On the Cactus mountains and at the head of Williams River, degrees 113½ longitude " Arizona, *Bigelow* in 1853–4 *Mo* (3) Var. *chrysocentrus*, "It was found where *C variegatus* [var *variegatus*] disappears on the lower part of Williams's River, and was seen from there to Mojave Creek, and up that stream to the Sierra Nevada " Western Arizona and California, *Bigelow* in 1853–4, *Mo* The species is barely to be maintained as distinct from *E Fendleri*, and the separation is rather arbitrary

3A **Echinocereus Engelmannii** var **Nicholii** L Benson, var nov

Plate 25, fig B

Caulibus 10–30 erectis, 3–5 dm longis, 5–7 vel 8 cm diametro, aculeis flavis, petalis colore similibus lavendulae

Stems erect, in large clumps of 10–30, 3–5 dm high, 5–7 or 8 cm in diameter, spines all yellow, petals lavender

Common on rocky hillsides in the Sonoran Desert at 1,000 to 2,000 feet elevation; not occurring on the alluvial flats between the mountains Arizona in western Pima County from the Organ Pipe Cactus National Monument to the Silver Bell Mountains, largely on the Papago Indian Reservation.

Type collection **Silver Bell Mine, Silver Bell Mountains, Pima County, Arizona,** *L Benson 10720,* March 28, 1941, TYPE *UA;* ISOTYPE *B* Mr. A A Nichol has brought many plants of this variety to the University of Arizona on the supposition that they were a new entity

3B. **Echinocereus Engelmannii** var **decumbens** (Clover and Jotter), L Benson, comb nov

Echinocereus decumbens Clover and Jotter, 1941, Bull Torrey Club, 68 417, fig 7, 1941

Stems decumbent, up to 50 or more, forming dense masses, elongated and slender, 2–6 dm long, 3–5 cm in diameter, spines yellowish to white or pinkish, the lower deflexed and flattened central spine 2 5–3 5 cm long, the other centrals and the radials 1 5–2 3 cm long, relatively weak and flexible, flowers unknown

Talus and ledges in precipitous canyons of the Sonoran Desert at about 2,000 to 3,000 feet elevation Arizona at Mile 16½, Marble Canyon, Colorado River, Coconino County, and at Palm Canyon, Kofa Mountains, Yuma County (*Benson and Darrow 10870 UA, B*) The Palm Canyon plant grew on top of a huge boulder where almost no soil was present, and it covered an area three or four feet in diameter

Type collection "Type on limestone ledge 30 feet from the river's edge and at the base of rocky talus at Mile 16½ Marble Canyon, Coconino Co , Arizona (*Clover and Jotter 2212*). Living specimen at the Botanical Gardens of the University of Michigan, Ann Arbor, Michigan (*Gard. 16870* Fig. 7)" Specimen now pressed

4 **Echinocereus Fendleri** (Engelm), Engelm *ex* Rümpler

Cereus Fendleri Engelm , *apud* A Gray, 1849, Mem Amer Acad., II 4 51
Cereus Fendleri var. *pauperculus* Engelm., A Gray, 1849, *loc cit*
Echinocereus Fendleri (Engelm), Engelm. *ex* Rümpler in Förster, 1885, Handb. Cacteenk , ed 2, p 801

Clumps not dense, the stems 1–5 or perhaps more, not crowded against one another, ovoid, 7–15 cm. long, 5–10 cm. in diameter, flaccid, ribs usually about 9–10, not markedly tuberculate at the areoles, spines not obliterating the surface of the stem, central spine 1, at first very dark brown to black, gray in age, turned upward from the base, tapering, 2–4.5 cm. long, stout, slightly curving upward the entire length, rigid, not flattened, radial spines 9–11, similar to the central but shorter and white or pale gray, areole circular, not bearing white felt at maturity, the felt rarely persisting two years, petals magenta to purplish, the flower about 5–7 cm. in diameter, floral tube about 12 mm. long above the ovary, fruit ovoid, about 3 cm. long, spiny, the spine-clusters interlocking, falling away as a sheet at maturity.

Grassland and open areas in the Rocky Mountain Forests at 5,000 to 7,000 feet elevation. Northern Arizona in Coconino, Navajo, and Apache counties, southern Utah, northern New Mexico.

Type collections: (1.) *C. Fendleri*, "Santa Fe, on elevated sandy plains, flowering in June." *Fendler, Mo.* (2.) Var. *pauperculus*, apparently collected in the same vicinity by Fendler, *Mo.*

4A. **Echinocereus Fendleri** var. **rectispinus** (Peebles), L. Benson, comb. nov.

Echinocereus rectispinus PEEBLES, 1938, Amer. Jour. Bot., 25: 675, f. 1, 3d.

Stems 1–5, usually 1–2 dm. high, 6–9 cm. in diameter, firm, the ribs 8–10, central spine perpendicular to the stem, straight, 1.2–2.5 cm. long, in some areoles accompanied by small accessory centrals, rigid, rather stout, flower about 6–6.5 cm. in diameter.

Rocky slopes and benches in the Desert Grassland at 3,500 to 5,500 feet elevation. Arizona from Nogales and the Santa Rita Mountains to Ft. Grant and Cochise County.

Type collection: "*Type: Peebles No. SF 905* (fig. 1), hills near Nogales, Arizona, elevation 3,900 feet, May 5, 1935, represented by a living plant under cultivation at U. S. Field Station, Sacaton, Ariz., and by material deposited in the U. S. National Herbarium as *No. 1729966.*"

4B. **Echinocereus Fendleri** var. **robustus** (Peebles), L. Benson, comb. nov.

Echinocereus rectispinus Peebles var. *robustus* PEEBLES, 1938, Amer. Jour. Bot., 25: 675, f. 3c.

Echinocereus robustus PEEBLES, 1940, Jour. Wash. Acad. Sci., 30: 219.

Stems 5–20, 1.7–4.5 dm. high, mostly 8–10 cm. in diameter, ribs 8–13, firm, central spine straight, perpendicular to the stem, 2.5–7.5 cm. long, in some areoles accompanied by small accessory centrals, rather flexible, slender; flower usually 7.5–8.5 cm. in diameter.

Rocky slopes in the Sonoran and Chihuahuan deserts and the lower part of the Desert Grassland at 2,000 to 4,000 feet elevation. Arizona from eastern Pinal County and eastern Pima County to the upper Gila River valley and the lower parts of Cochise County. This is the only *Echinocereus* in the desert about Tucson. Flowering in April and May. Closely related to the next variety.

Type collection. "*Type Peebles No SF 896*, Tucson to Sabino Canyon, Pima County, Arizona, August 27, 1935, represented by a living plant grown under cultivation at Sacaton, Ariz., and by material deposited in the U S. National Herbarium as *No 1729967.*"

4c **Echinocereus Fendleri** var **Boyce-Thompsonii** (Orcutt), L Benson, comb nov

Echinocereus Boyce Thompsonii ORCUTT, 1926, Cactography, (3). 4

Stems 1–10, 1–2 5 dm high, 5–7 5 cm in diameter, rather firm, ribs 12 or commonly 14–18 or sometimes more, central spine 2 5–4 cm long, accompanied in at least some areoles by 1 or 2 accessory centrals, perpendicular to the stem or more commonly deflexed, straight, flexible, very slender, remarkably light-colored, either straw-colored, reddish, or white (gray in the two preceding varieties), flower usually about 6–6 5 cm in diameter This variety is transitional in some of its forms to *Echinocereus Engelmannii*

Rocky slopes or grassy uplands in the upper part of the Sonoran Desert, the Desert Grassland, the Southwestern Coniferous Woodland, and the Southwestern Oak Woodland at mostly 2,500 to 5,500 feet elevation Central Arizona from the vicinity of Seligman southeastward just below the Mogollon Rim to the upper Gila River Valley. Flowering from March until May

Type collection "Grounds of the Boyce Thompson Southwestern Arboretum, near Superior, Arizona, at an elevation of about 2,300 feet" The original description was reprinted by Peebles, Amer Jour. Bot, 25 677 1938.

4D **Echinocereus Fendleri** var **Bonkerae** (Thornber and Bonker), L Benson, comb nov.

Echinocereus Bonkerae THORNBER and BONKER, 1832, Fantastic Clan, p 71–3, 85, pl. opposite p. 28, 72

Clumps rather dense for the group, the stems usually 5–15, 1.2–2 dm. high, 3 5–6.5 cm in diameter, rather firm, ribs 11 or 13–16; central spine 6–8 mm long, accompanied in some areoles by 1 or 2 accessory centrals, perpendicular to the stem, rigid, white or pale gray tipped with brown; flower tending toward purple, about 6–6 5 cm in diameter, the petals and sepals more nearly rotate than in the other varieties, or even slightly reflexed.

Hills and slopes in the Desert Grassland and the Southwestern Oak Woodland at 3,500 to 5,000 feet elevation, best developed in shady situations where leaf-mold is present Arizona from the vicinity of Globe to the Santa Catalina Mountains and the Graham (Pinaleno) Mountains Specimens collected by A A Nichol in 1940 are clearly transitional between this and var. *Boyce-Thompsonii*

Type collection "We are nearing the beautiful Pinal Mountains in southeastern Arizona . " According to A A. Nichol, the plant described by Professor Thornber was from near Oracle at the north base of the Santa Catalina Mountains. Mr. Nichol planted the specimens in the University of Arizona Cactus Garden, and in 1939, the writer placed the remains of the last individual in the University Herbarium. They are the closest approach to a type Coulter, Contr U. S. Nat. Herb, 3. 394, 1896, described a plant probably of this variety from Oracle (*Evans* in 1891), placing the vegetative material near *Cereus ctenoides*

Engelm (*Echinocereus pectinatus* var *neomexicanus* above). Britton and Rose, Cactaceae, 3: 37, 1922, published a photograph of this plant (fig 45) as *E Fendleri*.

5 **Echinocereus Ledingii** Peebles

Echinocereus Ledingii PEEBLES, 1936, Cact and Succ. Jour , 8 35

Clumps not particularly dense, longer stems cylindrical, 1 5–4 or 5 dm high, 6–9 or 10 cm in diameter, ribs 12–16, not markedly tuberculate at the areoles, spines not completely obliterating the surface of the stem, light yellow or straw-color; central spine 1, but often accompanied by 1–3 short upper accessory centrals, deflexed and strongly curved downward near the base, about 2 cm long, stout, rigid, tapering, radial spines about 10–12, straight, about 9 mm long, areole circular or nearly so, not bearing white felt, petals rose-purple, the flower 3 5–5 cm in diameter, floral tube about 9 mm long above the ovary, fruit pale green, spherical, a little less than 1 inch in diameter, spiny when young

Slopes in the Southwestern Oak Woodland at 4,500 to 6,000 feet elevation. Southeastern Arizona in the Quinlan, Santa Catalina, Santa Rita, Huachuca, Graham (Pinaleno), and Chiricahua Mountains in Pima, Graham, Santa Cruz, and Cochise counties Perhaps endemic in Arizona The localities are based upon records supplied by A A Nichol, specimens have been obtained only from the Graham Mountains

Type collection "Type collected at about 4,500 feet elevation on slopes of Mt Graham, Pinaleno Mountains, Graham Co , Arizona, Louis Wankum, July 11, 1935, U S Nat Herb No. 1,634,004 "

ECHINOCACTUS

In this genus only a few changes are proposed now, and other problems are deferred pending accumulation of additional data

Echinocactus acanthodes Lemaire

Echinocactus acanthodes LEMAIRE, 1839, Cact Gen Nov Sp , p 106
Echinocactus viridescens var *cylindraceus* ENGELM., 1852, Amer Jour Sci , II 338
Echinocactus LeContei ENGELM , 1856, Pac. R R. Rept , 4 29
Echinocactus cylindraceus ENGELM , 1857, Proc Amer Acad , 3 275
Echinocactus Wislizeni Engelm var *LeContei* Engelm. in ROTHROCK, 1878, Rept U S Geogr Surv., 6 128
Ferocactus LeContei BRITT and ROSE, 1922, Cactaceae, 3 129
Ferocactus acanthodes BRITT and ROSE, 1922, *loc cit*
Ferocactus Rostii BRITT and ROSE, 1922, *loc cit.*, p 146
Echinocactus Hertrichii WEINBERG, 1929, Desert, 1 40
Ferocactus acanthodes var. *Rostii* W T Marshall in MARSHALL and BOCK, 1941, Cactaceae, p. 148.

The common barrel cactus in western and central Arizona does not seem to have any points of consistent difference from the type common in the California deserts. Previously (Benson *et al*, 1940) it was treated as a species pending further investigation, but with the following statement, "Probably merely a form of *Echinocactus acanthodes*."

Type collections. (1.) *E acanthodes*, type collected in California. (2.) Var. *cylindraceus*, "Found near San Felipe, on the eastern slope of the California Mountains." Colorado Desert, San Diego County, *Parry*, *Mo* (3) *E. LeContei*, "This gigantic species was first noticed by Dr John L LeConte, on the lower Gila, where also Dr C. C Parry saw it . Subsequently, Dr Bigelow met with this remarkable plant, abundantly from the Cactus Pass, at the headwaters of Williams' River down this stream to the Colorado, and west of it till *E polycephalus* took its place " (4) *F Rostii*, "The type is based on a plant collected in Lower California, 40 miles south of the International Boundary Line (Rost No 327) " (5.) *E. Hertrichii*, "Type specimen Huntington's Botanischer Garten und Museum, San Marino, California." "Type—Weinberg in Henry E Huntington's Botanic Garden, San Marino, Calif Locality—Tortilla and Gila mountains, Arizona "

Echinocactus polycephalus Engelm var **xeranthemoides** Coulter

Echinocactus polycephalus Engelm var *xeranthemoides* Coult, 1896, Contr U S Nat Herb, 3 385
Echinocactus xeranthemoides Engelm *ex* Coult, 1896, loc cit, as syn
Echinocactus xeranthemoides Engelm *ex* Rydb, 1917, Fl Rocky Mts. and adj Plains, p 579

Stems rarely more than 12, the largest ones 1–2 dm in diameter, the clump usually asymmetrical, that is, the tallest stem on the edge, spines glabrous, yellow or pale gray tinged with red or sometimes pink or light red, central spines spreading at right angles to the stem (In the typical variety stems commonly 10–30, the larger ones 2–3 dm in diameter, the clump symmetrical, that is with the largest stem in the center, spines densely covered with felt when young, red, central spines spreading each in a low arc)

Rocky, south-facing ledges in the Southwestern Coniferous Woodland at 4,000 to 7,000 feet elevation Arizona in the northern edge of Mohave County and along the Colorado River system from Lee's Ferry and Canyon Diablo to the Grand Canyon region; southern Utah

Type collection "Type, Siler of 1881 and 1883 in Herb Mo Bot Gard "

MAMMILLARIA

As in *Echinocactus* and *Opuntia*, although a number of problems exist, data for solution of some of them are inadequate Only the following changes are proposed

Mammillaria vivipara (Nutt) Haw var **aggregata** (Engelm), L Benson, comb nov

Mammillaria aggregata Engelm in Emory, 1848, Notes Mil Reconn, p 146
Cereus aggregatus Coult, 1896, Contr U S Nat Herb, 3 396
Echinocereus aggregatus Rydb, 1906, Bull Torrey Club, 33 146
Coryphantha aggregata Britt and Rose, 1923, Cactaceae, 4 47

Low-growing plant, the stems at first solitary but later forming mounds 2–6 dm high and up to 6 dm in diameter; stems 4–5 cm in diameter at maturity, tubercles cylindrical, about 8–10 mm high, about 6 mm in diameter, the surface of the stem obliterated by spines; central spines usually 5–6, white tipped with brown, straight, the upper ones turned upward, 1.5–2 cm long, the lower ones spreading at various angles from the stem, about 6–9 mm. long, tapering, slender but rigid, not flattened, the centrals appearing after the radials and not present in young stems; radial spines 15–20, similar to the centrals, white, slightly brownish at the extreme tips, 12–18 or 25 mm long, somewhat flattened, petals usually lavender or pink, oblanceolate, rather abruptly acuminate, 4–6 mm. broad, the flower about 3 5–4 cm in diameter; fruit green with a dull purplish tinge, ellipsoid, about 2 5 cm long, 1 8 mm in diameter

River bottoms, the desert floor, or most frequently on grassy plains or rocky slopes in the upper part of the Sonoran Desert, the Desert Grassland, and the Southwestern Oak Woodland and Chaparral at 3,000 to 5,000 or 6,000 feet elevation The eastern half of southern Arizona, largely south of the Mogollon Rim, New Mexico on the Gila River drainage, Sonora. Flowering in May and June

Type collection "Oct 18, 1846 Head waters of the Gila, 6,000 feet above the sea" Interpretations of the type have alternated between this plant and *Echinocereus triglochidiatus* var *melanacanthus* Engelmann, *loc cit*, first interpreted the plant as a member of the *Mammillaria vivipara* complex, and (as pointed out by Peebles apud Kearney and Peebles, U S Dept Agric Misc Publ, (423) 605, 1942, the original drawing shows crossed spirals indicating tubercles on the stem The type was not preserved, or was lost

Mammillaria vivipara var **arizonica** (Engelm) L Benson, comb nov

Mammillaria arizonica Engelm in BREW and WATS, 1876, Bot Calif, ed 1, 1 244
Cactus radiosus (Engelm) Coult var *arizonica* COULT, 1894, Contr U S Nat Herb, 3 121
Mammillaria radiosa Engelm var *arizonica* K SCHUM, 1898, Gesamtb Kakteen, p 481
Coryphantha arizonica BRITT and ROSE, 1923, Cactaceae, 4 45

Stems solitary at first, later forming great mounds, spines predominantly dark brown, lower central spines 2, one of these spreading perpendicularly (to the areole), the other turned downward, petals deep pink, linear-lanceolate, gradually acuminate, 2 5–4 mm broad.

Rocky places in the Southwestern Coniferous Woodland and the Rocky Mountain Forests at 4,000 to 8,000 feet elevation Southwestern Utah, northern Arizona from Mohave County to Apache County and southward to the Mogollon Rim and the White Mountains, and perhaps farther in the higher mountains

Type collection "On sandy and rocky soil in Northern Arizona, from the Colorado eastward (*Coues, Palmer, F Bischoff*), and into Southern Utah (*J E Johnson*) "

Mammillaria vivipara var **deserti** (Engelm), L Benson, comb nov

Mammillaria chlorantha Engelm *apud* Rothr, in WHEELER, 1878, U S Geogr Surv. W of 100th Merid, 6 127
Mammillaria deserti Engelm. in S. WATS, 1880, Bot Calif, 2 449
Cactus radiosus (Engelm) Coult var *deserti* COULT, 1894, Contr U S Nat Herb, 3 121.
Cactus radiosus var *chloranthus* COULT, 1894, *loc. cit*
Cactus radiosus var. *Alversonii* COULT, 1894, *loc cit*, p 122.
Mammillaria Alversonii ZEISSOLD, 1895, Monatsschr. Kakteenk., 5 70
Mammillaria radiosa Engelm var *deserti* K SCHUM, 1898, Gesamtb Kakteen, p. 481

Mammillaria radiosa var. *chlorantha* K. SCHUM., 1898, *loc. cit.*
Mammillaria radiosa var *Alversonii* K. SCHUM., 1898, *loc. cit.*
Coryphantha chlorantha BRITT and ROSE, 1923, Cactaceae, 4 · 43
Coryphantha arizonica BRITT and ROSE, 1923, *loc cit.*, p. 45.
Coryphantha deserti BRITT and ROSE, 1923, *loc cit* , p 45.
Mammillaria arizonica Engelm. var. *deserti* Engelm *ex* DAVIDSON and MOXLEY, 1923, Fl. S Calif., p 244.
Mammillaria arizonica var *Alversonii* Engelm *ex* DAVIDSON and MOXLEY, 1923, *loc cit.*
Coryphantha Alversonii ORCUTT, 1926, Cactography, (3) : 3

A robust type with the stems usually solitary or sometimes few, these 7–20 cm high, 5–7 5 cm in diameter, central spines 3–14, usually white tipped with brown, straight, spreading at all angles, 12–18 mm. in length, averaging long, tapering, stout, rigid, not flattened, radial spines about 20, similar to the centrals but more slender, white; petals straw-colored, yellow, pink, or purple, the flowers 2 5–3 5 cm in diameter.

Rocky slopes in the Mojavean Desert at 1,500 to 3,500 feet elevation California in the ranges of the eastern and southern parts of the Mojave Desert, southern Nevada; southwestern Utah, northwestern Arizona in northern and western Mohave County A variable plant possibly to be segregated into more than one variety with accumulation of additional data. The characters of the proposed segregates seem inconsistent in their association

Type collections (1) *M chlorantha*, "Southern Utah, east of Saint George, Dr. Parry I E Johnson." (2) *M deserti*, "At Ivanpah, 30 miles northeast of San Bernardino, in one of the mountain ranges stretching into the desert, *S. B Parish.*" *Mo* Ivanpah is in the New York Mountains, about 140 miles northeast of San Bernardino, California (3) Var. *Alversonii*, "Type, Alverson's specimens in the Herb Mo Bot Gard. and Herb Coulter .. SOUTHERN CALIFORNIA (*A H Alverson* of 1892) . The decidedly pink flowers were sent by Mr S B Parish from specimens growing in cultivation in San Diego, and are not from the original collection of Mr Alverson"

Mammillaria Heyderi Mühlenpfordt

Mammillaria Heyderi MÜHLENPFORDT, 1848, Allg. Gartenz., 16 20.
Cactus Heyderi KUNTZE, 1891, Rev Gen et Sp Pl., 1 260
Neomammillaria Heyderi BRITT and ROSE, 1923, Cactaceae, 4 75

Obscure depressed cactus arising only 1–5 cm. above ground level; stem solitary, shaped like a turnip, flat-topped, half or two-thirds subterranean, 5–8 cm long, 7–12 cm in diameter, the tubercles conical, 6–10 mm high, 5–7 mm in diameter, juice of the plant milky, central spines 2–3, white tipped with dark brown, straight and subequal, 6–8 mm. long, tapering, slender, rigid, not flattened, radial spines 10–15, petals pink, sepals not fringed, flower 10–12 mm in diameter.

Limestone hills in the Chihuahuan Desert or the Desert Grassland at 3,500 to 5,000 feet elevation Along the Mexican Border in Cochise County near Bisbee (*Peebles SF 923, Sac, UA*) and in the Peloncillo Mountains (*L. Benson 10272, UA, B*) One of several Chihuahuan Desert plants barely reaching southeastern Arizona and there restricted to favorable limestone soils.

Type collection none given

Mammillaria Heyderi var. **MacDougalii** (Rose) L. Benson, comb. nov.

Mammillaria MacDougalii Rose in Bailey, 1916, Stand. Cyclop. Hort., ed. 1. 4: 1982.
Neomammillaria MacDougalii Britt. and Rose, 1923, Cactaceae, 4: 74.

Stems 5–7.5 or 12.5 cm. long, 7.5–17.5 cm. in diameter; central spines straight or the principal one curving gradually outward; petals cream-colored or light yellow; sepals fringed; flower about 17–20 mm. in diameter.

South exposures of rocky hill crests in the Desert Grassland and the Southwestern Oak Woodland at 4,000 to 6,000 feet elevation, often in crevices of rocks or in rocky soil. Arizona from the Baboquivari Mountains eastward to the Santa Catalina Mountains and to southern Cochise County; probably in adjacent Sonora. Often associated with *Echinocereus pectinatus* var. *rigidissimus*, the Arizona rainbow cactus. Flowering late in March and in April.

Type collection: "Common in the mountains about Tucson, Ariz., where it was collected by D. T. MacDougal, for whom it is named."

The dimorphic fruits of some of the typical *Mammillaria* species, including *M. Heyderi* and the variety *MacDougalii* have been well-known for some time, and Peebles, Cact. and Succ. Jour., 13: 143–5, 1941, has reported and illustrated similar types (clavate-red and spherical-green) in *Mammillaria microcarpa*. They occur also in *Mammillaria fasciculata* (15 miles west of Silver Bell, Pima County, Arizona, *L. Benson 10606, UA, B*).

The plants described previously as *Mammillaria microcarpa* Engelm., *M. fasciculata* Engelm., *M. Wilcoxii* Toumey, *M. viridiflora* (Britt. and Rose) Boed., and *M. Mainae* K. Brandegee are in need of further study, but at present data are inadequate.

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EXPLANATION OF PLATE

Plate 25

Opuntia and *Echinocereus* *A*, *Opuntia*, *1*, *Opuntia compressa* var *macrorhiza*, collected at Pearce, Arizona, by A. A Nichol in 1940, *2*, *Opuntia compressa* var *macrorhiza*, from sand hills near Guion, Arkansas, *Demaree #3490*, *3*, *Opuntia compressa*, from the Atlantic seaboard, received from cultivation in Massachusetts, *B* *Echinocereus Engelmannii* var *Nicholii*, growing in the Ajo Mountains, Arizona (Photograph *A* by Robert A Darrow, *B* by Walter S Phillips.)

A
1
2
3
B

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No. 11

ENDEMISM IN *CREPIS*

BY

ERNEST B. BABCOCK
Professor of Genetics
University of California

I INTRODUCTION

ONE RESULT of the extensive investigations on the genus *Crepis* has been the formulation of a fairly definite hypothesis concerning the origin, development and migrations of this essentially monophyletic group of plants This hypothetical history of the one hundred and ninety-six species of *Crepis* has been found to be consistent with a great mass of other evidence concerning the origin and migrations of floras in the northern hemisphere A review of this evidence together with a detailed discussion of the data on *Crepis* will be presented in a monograph which is in press

The criteria of phylogenetic relations in *Crepis* represent five different disciplines The primary basis for classifying all the species into twenty-seven sections and arranging the sections in an approximate phyletic series is comparative morphology Second in importance have been the data on chromosome numbers in one hundred and thirteen of the species (cf. Babcock and Jenkins, 1943) Thirdly, the cytogenetic analysis of certain interspecific hybrids has confirmed the conclusions reached concerning the phyletic relations of the parent species as determined on the basis of comparative morphology and chromosome numbers, and has revealed the evolutionary process by which reduction in chromosome number in the series 6–5–4–3 has been accomplished (cf Babcock, 1942, pp 176–178; Tobgy, 1943). Fourthly, purely genetic data on many interspecific hybrids have substantiated the grouping of

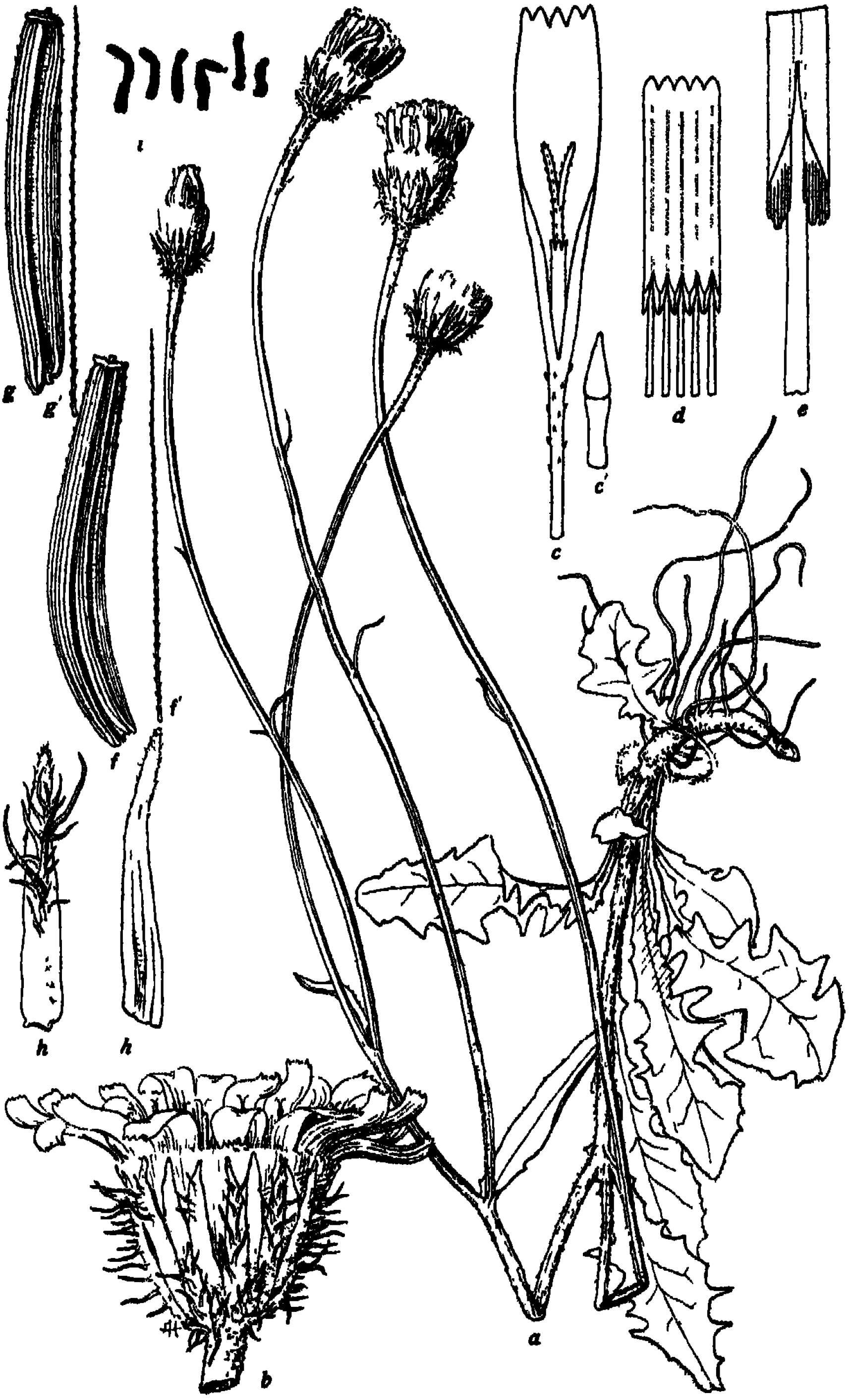

Fig 1 *Crepis geracioides* Hausskn *a*, plant, × ½, *b*, flower head, × 2, *c*, a floret lacking the ovary, × 4 *ca*, *c'*, trichome from the corolla tube, × 100 *ca*, *d*, anther tube slit and opened out, × 8 *ca*, *e*, detail of anther appendages, × 32 *ca*; *f*, *g*, two achenes and a pappus seta from each, × 8 *ca*, *h*, *h'*, two inner involucral bracts showing outer and inner faces respectively, × 4 *ca*, *i*, haploid set of chromosomes, × 1500

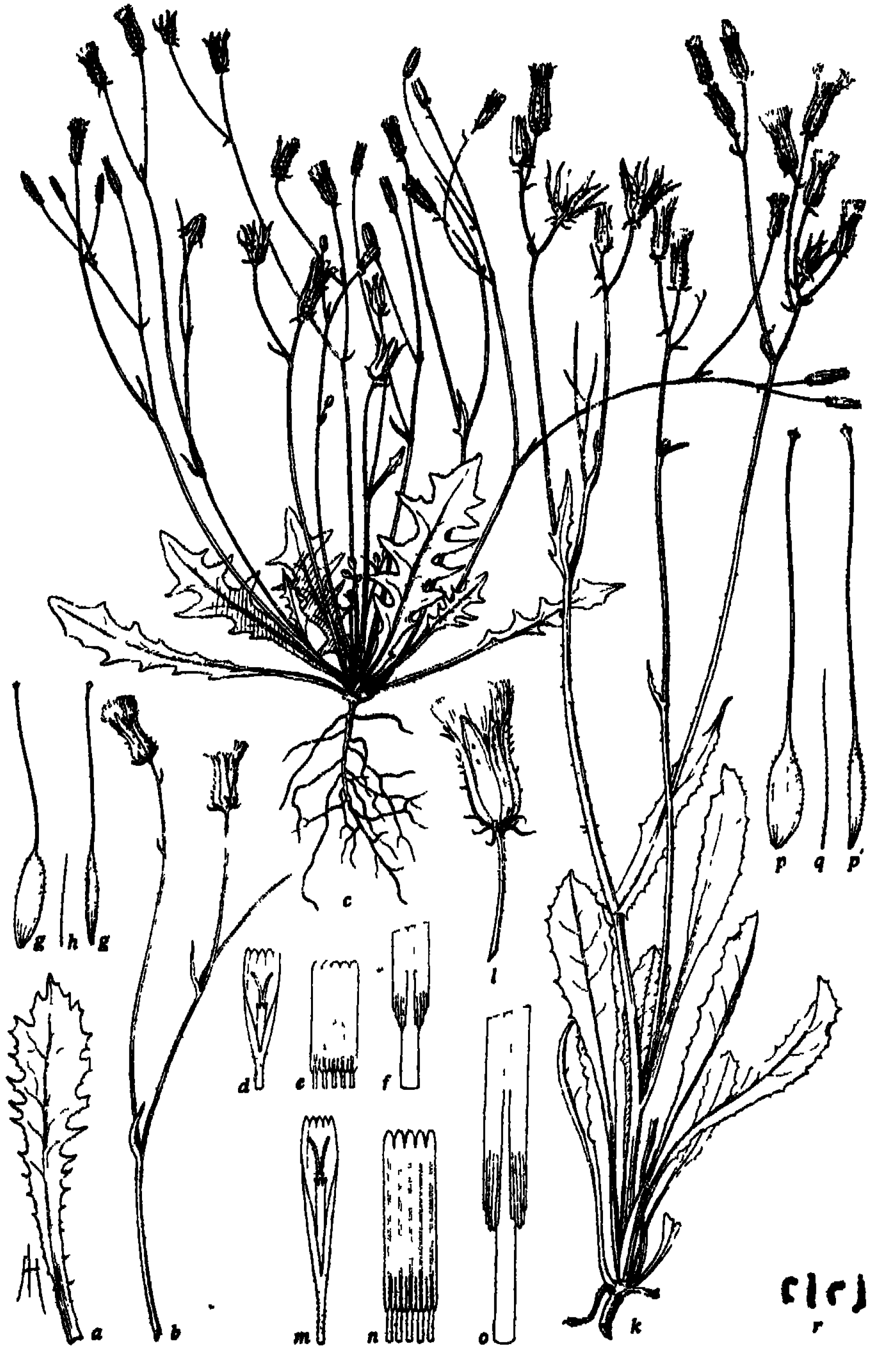

Fig 2 *Crepis senecioides* Delile *a, b, c* and *k*, plants and parts, × ½, *d, m*, florets lacking the ovary, × 4 *ca*, *e, n*, anther-tubes slit and opened out, × 8 *ca*, *f, o*, details of anther appendages, × 32 *ca*, *g, h, p, q*, achenes and single pappus-setae, × 8*ca*, *r*, haploid set of chromosomes, × 1500

the species into sections on a morphological basis; and the genetic analysis of hybrids has shown the importance of gene mutation as a cause of speciation in *Crepis* Fifthly, a study of geographic distribution in the genus as a whole, taken section by section, when considered in the light of well-established paleobotanical evidence, has led to the formulation of a phylogenetic history of the genus

In order to give the reader a concrete notion of the morphological contrasts between the most primitive and most advanced types of *Crepis* species, one of each is illustrated (figs 1 and 2) The differences in size and habit of the plant, in size of the heads, florets, fruits, etc , are so obvious, it seems hardly necessary to point them out The primitive species, *C geracioides,* is a montane perennial which is endemic in the southern Balkan Peninsula The advanced species, *C senecioides,* is a precocious, desert annual which has been collected at a number of stations scattered along the Egyptian-Tunisian littoral Because of its wide distribution it is not considered to be an endemic species in the restricted sense in which that term is used in the present paper But, since it is the most advanced species in the genus on morphological grounds, it has been used to illustrate the extreme reduction in size which has accompanied development of the annual habit, extreme precocity, and remarkable longevity of the tiny seeds (achenes), all of which adapt it so well to desert conditions The fact that these two species, which represent the earliest and latest stages in a very long developmental history, now exist on opposite sides of the Mediterranean Sea, which is only some 600 kilometers (400 miles) wide in this region, is sufficient to pique one's curiosity as to whence and how they came to be there

Stated as briefly as possible, the answer is as follows *Crepis* originated in Central Asia early in the Tertiary period Some, at least, of the most primitive species existed at low elevations, under mesophytic conditions But migration into higher altitudes, accompanied by speciation, must have occurred during the early development of the genus and before the extensive migrations took place to the northeast, southeast, northwest and southwest from Central Asia. The migrations to the southwest affected a much larger number of *Crepis* species than the other three migrations The general trend of the southwesterly migration passed through Turkestan and Iran and then followed one of three main routes· (1) through northern Asia Minor into the Balkan Peninsula and southern Europe, (2) through southern Asia Minor, Iraq, Syria and Palestine into Egypt, and (3) through southern Arabia into Abyssinia and tropical Africa These migrations were accompanied or followed by increasing dessication in southwestern Asia and the Mediterranean region and this, together with the many topographical changes which occurred, resulted in increased speciation throughout that general region. Thus *C. geracioides* almost certainly migrated from Central Asia around the south end of the Caspian Sea, through northern Asia Minor, into the Balkan Peninsula where it still exists in three localities But *C senecioides* almost certainly developed where it now exists from some less advanced ancestor which was unable to tolerate the increasing aridity of the climate That ancestor, in turn, probably developed from a still more primitive type somewhere in the Iran-Iraq region. A presentation of the general background of evidence for these rather dogmatic statements must await the publication of the monograph.

One of the most interesting aspects of the geographic distribution of *Crepis* is the large amount of endemism present and the distribution of the endemic areas. It is the purpose of the present paper to examine this evidence in order to determine to what extent it agrees with the phyletic history briefly outlined above, which was worked out for the genus as a whole At the same time it may be possible to derive some conclusions concerning endemism in *Crepis* which will have general significance

The present study is confined to the Old World species inasmuch as the data on endemism in the New World species have already been reported (Babcock and Stebbins, 1938) With reference to the history of the genus as a whole, the conclusion was reached that all of the American species either migrated from Asia across the Beringian land-bridge before the Pleistocene glaciation could prevent such migrations, or that they were derived from species of Asiatic origin

The term endemic, in its usual biological connotation, is applied to a plant or animal which is restricted in its distribution to a single country, region or area This definition becomes much more definite as soon as the size of the region or area is stated During the years spent in accumulating data of various kinds concerning *Crepis* species, the writer came to realize that a great many of them are endemic in the general sense defined above, and that a considerable number of them are also of very restricted distribution Some of these restricted species are insular, being confined to one or other of such islands as Crete, Sicily, Majorca, Madeira or Fuerteventura and Lanzarote of the Canary Archipelago Others are restricted to a single limited district on a continent, as in the case of the 22-chromosome forms of *C monticola* and *C pleurocarpa,* two of the oldest endemic American species of *Crepis* (cf Babcock and Stebbins, 1938) Still others are similarly restricted by ecological factors, but they occur in two or more small districts and these may be either near together or widely separated within a given endemic area An example of the latter is *C. geracioides;* but the three localities at which *C geracioides* is known to occur are separated by a maximum distance of approximately 150 kilometers (90 miles) Hence this species can hardly be described as a *narrow* endemic except in a purely relative sense, as when compared with such a widespread species as *C senecioides*

In order to obtain more definite information as to the amount and possible significance of endemism in *Crepis,* it was decided to set arbitrarily a lower limit of fifty kilometers (30 miles) and an upper limit of 150 kilometers (90 miles); and to classify all the species whose maximum straight-line distance between known localities falls within the lower limit as "narrow A", all those whose maximum distance between known localities exceeds the upper limit as "wider", while those falling between the two limits were classed as "narrow B." It was found that there were so few species in the "narrow B" group that, for the sake of simplicity, the "narrow B" and "wider" groups were lumped together, thus recognizing only two categories, "narrow" and "wider," with the dividing line at 50 kilometers

On this basis it was found that there are forty-eight species of *Crepis* for which the available data indicate a "narrow" distribution Twenty-eight of these are known from only one locality while the other twenty are known from two or more localities Of the twenty-eight that are known from a single locality, twenty-four are known to the writer from just one collection; but the other four are known to have been collected several times at the one locality. Three of these four localities are mountain peaks in Greece; the other is the eastern promontory of Madeira Island The twenty-four localities at which only a single collection has been made are mostly in regions which have been less thoroughly explored botanically, such as Asia Minor, the Caucasus, Turkestan and tropical Africa Many of these localities are in mountainous country and some are mountain peaks Since many of the "wider" endemics are known to be very local in their distribution, and half of the "narrow" ones are known from two or more collections, it is fairly probable that the majority of the species known from only one collection will turn out eventually to be actually "narrow" as here defined At any rate the purposes of the present paper can be served better by recognizing them as "narrow" than by ignoring them

Classification of the remainder of the *Crepis* species as endemic or not endemic was accomplished by defining a series of endemic areas and then by accepting as endemic only those known to be restricted to a single area. Many of these areas are widely recognized as rich in endemic species of plants By this method ninety-one species were selected as "wider" endemics This does not mean that these species are continuously distributed over a district more than 150 km (90 miles) in diameter On the contrary these "wider" endemics are all more or less local in their distribution, although a few are fairly abundant in certain districts Thus in the case of *C geracioides* it happens that the three known localities are about 150 kilometers distant from one another, whereas *C terglouensis,* another very primitive endemic, is known from at least twenty high alpine stations ranging from south-central Switzerland to central Tirol and Upper Austria. In marked contrast with these are such insular species as *C cretica* and *C canariensis* which are abundant on the islands where they exist. A few species have been omitted which occur mostly in one endemic area but are also represented in another and hence, on a less restricted criterion, might have been considered as endemic. Interesting examples are *C pygmaea,* a very primitive 12-chromosome species of Spain, the Pyrenees, the southwestern Alps and northern Italy; *C. smyrnaea,* another 12-chromosome primitive species known from only three localities in southern

Greece and western Asia Minor, C *pontana,* the most primitive 10-chromosome species of *Crepis,* which occurs from the eastern Alps to the western part of the Balkan Peninsula; and C *albida,* the next most primitive 10-chromosome species which is polymorphic and is distributed from the Grand Atlas Mts, in Morocco through Spain, the mountains of southern France and the Maritime Alps It becomes difficult to know where to draw the line, if one begins to go beyond the limits of a single endemic area But, on this restricted basis, there are still one hundred and thirty-three endemic species which is 72 per cent of the one hundred and eighty-five Old World species

II. THE DISTRIBUTION OF THE ENDEMIC REGIONS AND AREAS FOR *CREPIS*

The endemic regions and areas for *Crepis* are defined in Table 1 and shown on the accompanying map (fig 3) On this map the large size of the tropical African area (no 19) will be one of the first things to catch the attention It should be emphasized that, in the latter area, all of the eighteen endemic species found there are extremely local in distribution All but three occur on only one or two mountains or in a single mountain range These mountains and ranges are shown as solid circles or narrow ellipses on the map The other three species are known from only single stations which are at low elevation and these are shown as solid squares on the map Following is a key to the symbols used to designate these locations in area No 19 and three others in area No 10

The long winged-shaped ellipse in area No 10 is the Pamir-Ferghana-Altai system of mountains

KEY TO MAP SYMBOLS

Regions are indicated by Roman numerals Areas are indicated by Arabic numerals

Mountains shown by solid circles and ellipses:

AT.	**Ala tau Mts, Central Asia**
CH	**Mt. Chirinda, southeastern Africa**
DA.	**Darvas Mts, eastern Russian Turkestan**
CU	**Congo Uganda plateau north of Lake Kiwu, Africa.**
HI	**Himalaya Mts, Kashmir region, high alpine**
KE	**Mt. Kenya, eastern tropical Africa.**
KI	**Mt Kilimanjaro, eastern tropical Africa**
KU	**Mountains south of Lake Kiwu, tropical Africa.**
MC	**Mt Cameroon, western tropical Africa**
ME	**Mt. Meru, adjacent to Kilimanjaro**
NY.	**Mountains of Nyasaland and adjacent Congo**
RM	**Mt Rungwe and Mt. Mbeya, tropical Africa**
UK.	**Urundi Province, Kisozi, tropical Africa**
UL.	**Uluguru Mts., Tanganyika Prov, Africa.**
UT	**Ulu tau Mts., northern Russian Turkestan.**

Single lowland stations in Africa:

EC	Elizabethville, southeastern Belgian Congo.
FU	Fort Portal, Uganda
CA	Cului, Angola

TABLE 1

ENDEMIC REGIONS AND AREAS FOR OLD WORLD CREPIS

Regions	*Areas*
I Southwestern Europe, Alps, northwestern Morocco	1 S Spain and N W. Morocco
	2 N E. Spain and W France
	3 European Alps
II Balkan Peninsula	4 Balkan Peninsula
III Asia Minor, Syria Palestine, Crimea	5 Asia Minor
	6 Syria and Palestine
	7 Crimea
IV Caucasus, Iran	8 Caucasus region
	9 Iran
V Turkestan Pamir Altai region	10 Turkestan (E and N Russian) and the Pamir Altai mountains
VI Northwestern India	11 N W Himalaya Mountains, high alpine
	12 N W India Baluchistan, low montane
VII Southeastern Asia	13 S E Asia (= S E Tibet, S W China, N Burma, Laos, Annam)
VIII Eastern Siberia	14 E Siberia (Okhotsk district)
IX Northern Japan	15 Hokkaido Sakhalin
X Abyssinia, Eritrea, southwestern Arabia	16 S W Arabia in Yemen Province
	17 Eritrea
	18 N Abyssinia, mountains
XI Africa, tropical	19 Africa, tropical (isolated localities)
XII Lybia Morocco Cadiz (littoral), southern and western maritime Italy and southern France, Madeira and Canary Islands	20 Lybia (littoral)
	21 Tunisia (middle and southern)
	22 E Algeria (littoral)
	23 S Italy and Toscana, Sicily, Sardinia, Corsica, S France
	24 W. Algeria, N Morocco, Cadiz (mostly littoral)
	25 Madeira and Canary Islands

The distribution of the twelve endemic regions defines the east-west distribution of the genus as a whole almost completely, the gaps between the endemic regions being occupied more or less by the various widespread species In this connection it should be repeated that the total evidence on geographic distribution in *Crepis*, considered in relation to the evidence on phylogeny, definitely indicates that the center of origin and early development of *Crepis* was in Central Asia, in the Altai-Tian Shan mountain region in the northeastern part of region V (fig 3), and that the present wide distribution of the genus was accomplished through migration in four general directions from the center One of these trends was towards the northwest, into what is now Russia Only five species exist today in northern Europe as a result of that trend of migration and none of these is endemic Another migration trend was to the east and northeast, resulting in two endemics in Japan, one in the Okhotsk district of Siberia, (region VIII, fig 3), and all of the American species Still another trend was to the southeast, resulting in the nine endemic species found in region VII Most important of all the migration trends from Central Asia, in terms of the number of species involved, was the southwesterly trend across Turkestan and Iran From that region the three branches already mentioned led to northwest and tropical Africa, to the Caucasus, Asia Minor and southern Europe, and to the eastern Mediterranean and North African littoral The point to be emphasized here is that the distribution of the endemic regions for *Crepis* is entirely consistent with the generic history briefly outlined above.

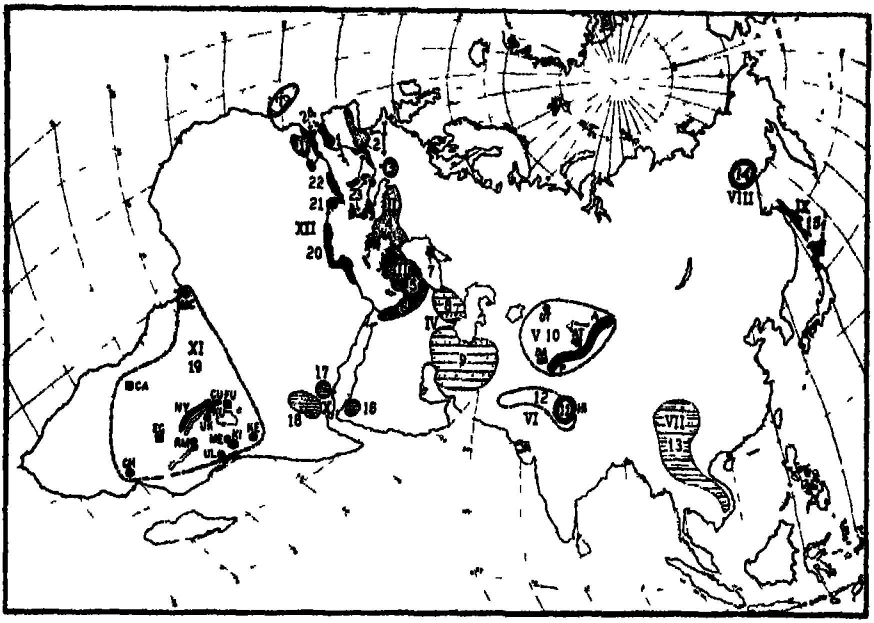

Fig 3 Map of the Old World showing the endemic regions (Roman numerals) and areas (Arabic numerals) for *Crepis* (In regions V and XI solid circles indicate single mountains and ellipses, mountain ranges or systems, solid squares indicate single lowland stations. See key to symbols in text)

III PHYLOGENY AND ENDEMISM IN *CREPIS*

Based on the evidence from comparative morphology and cytogenetics it has been possible to classify all the species of *Crepis* on a relative phylogenetic basis with some degree of assurance For purposes of the present discussion they have been grouped into three classes, the more primitive, the intermediate, and the more advanced species In Table 2 are shown the relations of the endemic species in these phylogenetic groups to the size of area occupied

TABLE 2

RELATIONS BETWEEN THE PHYLOGENETIC GROUPS OF 139 ENDEMIC SPECIES OF *Crepis* AND THEIR EXTENT OF NATURAL DISTRIBUTION, FLEVATION, GENERAL MOISTURE CONDITION, DURATION OF LIFE AND VARIABILITY

Phylogenetic groups	Distribution classes		Altitude classes			Moisture classes			Duration classes		Variability classes		Totals
	Narrow	Wider	Alpine	Montane	Low	Moist	Sub-humid	Arid	Perennial	Annual or biennial	Mono-morphic	Poly-morphic	
Primitive	11	18	7	18	4	6	18	5	29		26	3	29
Intermediate	28	47	24	28	23	12	46	17	75		61	14	75
Advanced	9	20		10	19		6	23	4	25	17	12	29
Totals	48	85	31	56	46	18	70	45	108	25	104	29	133

TABLE 3

RELATIONS BETWEEN THE EXTENT OF NATURAL DISTRIBUTION OF 133 ENDEMIC SPECIES OF *Crepis* AND THEIR PHYLOGENETIC GROUP, ELEVATION MOISTURE, DURATION OF LIFE AND VARIABILITY

NOTE —Numbers in the bottom two rows indicate percentages

Distribution classes	Phylogenetic groups			Altitude classes			Moisture classes			Duration classes		Variability classes		Totals
	Primitive	Inter-mediate	Advanced	Alpine	Montane	Low	Moist	Sub-humid	Arid	Perennial	Annual or biennial	Mono-morphic	Poly-morphic	
Narrow[a]	11	28	9	10	25	13	8	28	12	40	8	48		48
Wider	18	47	20	21	31	33	10	42	33	68	17	56	29	85
Totals	29	75	29	31	56	46	18	70	45	108	25	104	29	133
Narrow	*23*	*58*	*19*	*21*	*52*	*27*	*17*	*58*	*25*	*83*	*17*	*100*		*100*
Wider	*21*	*55*	*24*	*25*	*36*	*39*	*12*	*49*	*39*	*80*	*20*	*66*	*34*	*100*

[a] "Narrow endemics," as used here, are species having the maximum distance between known stations not more than 50 km (30 miles), "wide endemics" have the maximum distance between known stations more than 50 km. and 80 per cent of these have this distance exceeding 150 km (90 miles)

by each species (narrow or wider), to its altitude class (alpine, montane or low), its moisture classification (as occupying a moist, subhumid or arid environment), its life-duration class (perennial or annual-biennial), and its variability class (monomorphic or polymorphic).

Considering first the totals in the right hand column, it will be noted that twenty-nine of the endemic species are primitive and twenty-nine are advanced, whereas seventy-five, or more than one-half of them, are intermediate Evidently *Crepis* may be described as a conservative genus and this becomes more patent when it is realized that of the twenty-nine advanced endemics only some half-dozen desert or montane annuals can be considered as very highly specialized species There is apparently no correlation between the phylogenetic grouping and extent of distribution (narrow *vs* wider), since about one-third of all the endemics are narrow and two thirds are wider and these same proportions hold roughly for each of the three phylogenetic classes In altitudinal distribution there is positive correlation between primitive type and alpine altitude and very strong positive correlation between advanced type and low altitude In the moisture classes we find that, of the one hundred and four endemics in the primitive and intermediate groups taken together, just one-fifth occur under arid conditions, whereas four-fifths of the advanced endemics occur under arid conditions Hence there is strong positive correlation between advanced type and arid environment In the life-duration classes the differences are most striking—all the primitive and intermediate endemics are perennial whereas nearly all of the advanced endemics are annual or (in a few cases) biennial In regard to variability there is a stronger tendency towards polymorphism in the advanced than in the intermediate or primitive endemics *All of the primitive and intermediate endemics are perennial species and more than four-fifths of them are monomorphic and occur at montane or alpine elevations and under subhumid or moist conditions Most of the advanced endemics are annual species and two-fifths of them are polymorphic, none occur at alpine elevations and about three-fourths of them are found at low elevations and under arid conditions*

Having noted the lack of correlation between extent of distribution (as expressed by the arbitrary classes "narrow" and "wider" (and the three phylogenetic groups, it may be of interest to examine the relations between extent of distribution and the other four classifications of endemic *Crepis* species. In Table 3, in order to reveal the relations involved more clearly, the actual numbers, given in the upper two rows, are expressed in the lower two rows as percentages of the respective totals, given in the right-hand column. The totals given in the middle row are merely for the purpose of checking against the other tables Comparing these percentages, it is clear that there is little or no positive correlation between narrow and wider distribution and phylogenetic grouping. But it is equally clear that there is positive correlation of wider distribution with low altitude and arid climate. As for duration of life and variability, about four-fifths of both the narrow and the wider en-

TABLE 4

Relations of the Haploid Numbers, 6, 5, 4, 3, to the Phylogenetic Group, Extent of Natural Distribution, Elevation, Moisture, Duration of Life and Variability of 53 Endemic Species of *Crepis*

Note.—The polyploid endemics *C. ciliata*, *C. incana* and *C. taygetica*, are omitted.

Chromosome numbers	Phylogenetic groups			Distribution classes		Altitude classes			Moisture classes			Duration classes		Variability classes		Totals
	Primitive	Intermediate	Advanced	Narrow	Wider	Alpine	Montane	Low	Moist	Sub-humid	Arid	Perennial	Annual or biennial	Monomorphic	Polymorphic	
$n = 6$	6	3			9	3	3	3	2	3	4	9		7	2	9
$n = 5$	4	2	4	2	8	1	4	5		4	6	6	4	5	5	10
$n = 4$	5	13	15	6	27	6	4	23	5	14	14	21	12	22	11	33
$n = 3$			1		1		1				1		1		1	1
Totals	15	18	20	8	45	10	12	31	7	21	25	36	17	34	19	53

demics are perennial, whereas all of the narrow endemics are monomorphic, but one-third of the wider endemics are polymorphic

Considering these facts in the light of the conclusions derived from Table 2, it may be inferred that the advanced, annual endemic species which are polymorphic are mostly of wider distribution and occur at low altitude, under arid conditions This inference has been verified by reexamination of the original data There are twenty-five annual endemic species (Table 2) of which twenty-three occur in an arid climate and all but one of these at low altitude Only eighteen are known to have a wider distribution, but, of the other seven, six are known as yet only from the type locality and further collections may show that some of these also have a wider distribution

The contrast between this group of advanced endemics and the strictly alpine endemics is most striking Of the thirty-one alpine endemics, all are perennial, twenty-nine are monomorphic and only two, polymorphic, while all but one occur under subhumid or moist conditions Six of them are primitive, and twenty-five intermediate—there are no advanced alpine species *This means, of course, that the alpine endemics are all relatively old species and adapted to mesophytic conditions; whereas the lowland endemics of advanced type are relatively young species and adapted to xerophytic conditions*

But the contrast between the two groups does not hold for size of distributional area Of the thirty-one alpine endemics twenty-one are wider and only ten narrow in distribution Furthermore, there are ten other alpine species of *Crepis* which are so extensive in geographic distribution that they are not considered to be endemic For example, *C conyzaefolia* is a primitive alpine-subalpine species distributed from the Pyrenees to the Balkan Peninsula and in northern Asia Minor, Transcaucasia, northern Persia and the Altai region. Such evidence, together with the prevalence of wide distribution among the alpine endemics, certainly indicates that the *alpine endemics were formerly more widely distributed and have become restricted to their present locations presumably through radical changes in the environment*

The evidence on chromosome numbers is in good agreement with the foregoing generalizations In Table 4 fifty-three diploid endemic species are classified opposite their numbers 6, 5, 4, or 3, and in relation to phylogenetic grouping and the other classifications used in the preceding tables Phylogenetically, the 6-paired endemics are all primitive or intermediate, none are advanced, whereas the 5-paired endemics are about evenly divided among the three groups and the 4-paired endemics are mostly intermediate or advanced The one 3-paired endemic, *C fuliginosa,* is advanced, widely distributed, montane, xerophytic, annual, and polymorphic In distribution all of the 6-paired endemics are wider as well as most of the 5's and 4's, but the small number of narrow endemics that have been examined cytologically may be partly due to difficulties in obtaining them in living condition The data on altitudinal distribution indicate no correlations except in the 4-paired species which are mostly of low elevation As for moisture relations, most of the fifty-three species are about equally divided between subhumid and arid and this holds for each of the chromosome number classes. Under duration of life we find that all of the 6-paired endemics are perennial, whereas about one-third of both 5's and 4's are annual Obviously reduction in length of life has gone along with reduction in the number of chromosomes As for variability, there is little difference between the chromosome number classes in the proportion of monomorphic and polymorphic species The most significant facts derived from this analysis are (1) *The 6-paired species are mostly primitive and all perennial, but they are about equally distributed among the altitude and moisture classes* (2) *The 4-paired species are mostly intermediate or advanced and of low elevation, but they are about equally divided between mesophytic and xerophytic environments* (3) *These facts seem to indicate that adaptation from mesophytic to xerophytic conditions has been going on in this genus over a very long period of time*

IV THE DISTRIBUTION AND PHYLOGENY OF *CREPIS* ENDEMICS

In Table 5 each of the endemic *Crepis* species is tabulated according to the endemic region in which it occurs and its phyletic, altitude and life-duration class, also the fifty-three endemics that have had their chromosomes counted are tabulated according to chromosome number as well as the region where they occur

Considering first the primitive endemics, it will be noted that two grades are recognized, A and B. The thirteen species in the A group are definitely more primitive than those of the B group on morphological grounds Eleven of these most primitive endemics are either alpine or montane, and restricted to southwestern Europe or the Balkan Peninsula or to a few high mountains in tropical Africa The other two are alpine species, one in the western Himalaya Mountains and the other in the northern islands of Japan Thus the most primitive *Crepis* endemics are now mostly distributed at great distances from the assumed center of origin for the genus Since most of the advanced endemics are closer to Central Asia than southwestern Europe, the distribution of the most primitive and most advanced endemics in *Crepis* conforms in general with Matthew's principle of radial distribution of older types from a common center accompanied by the development of more advanced types nearer the center (Matthew, 1915) This conformity with Matthew's principle is also apparent from the distribution of all the species (including the endemics) in several of the more primitive sections of *Crepis* These facts provide a sound basis for the hypothetical history of *Crepis* which starts with the origin and early development of the genus in Central Asia.

Considering next the totals for the twelve regions (Table 5, left-hand column), it is clear that the greatest concentrations of endemics exist in the Balkan Peninsula, in Asia Minor and adjacent areas, in tropical Africa, and in the Mediterranean littoral But these four regions differ as to the phylogenetic status of their endemics. In the Balkan Peninsula close to one-half of the endemics are intermediate, whereas, one-fourth are primitive (A+B) and one-fourth, advanced These twenty-six species are similarly divided between montane, alpine and low elevations, the seven advanced species are all annuals Evidently the highly diversified conditions in that region have favored the persistence of both primitive and intermediate endemics as well as the development of advanced endemics In Asia Minor and the Mediterranean littoral, however, the endemics are all either intermediate or advanced But the fact that there are no primitive endemics in Asia Minor is probably due to the generally more arid climate of that region as compared with the Balkan Peninsula as a whole In tropical Africa, on the other hand, we find just the opposite situation The eighteen endemics are all either intermediate or primitive, and this is also true of four other tropical African species which are so widely distributed that they are not included here as endemics This absence of advanced species in tropical Africa probably indicates that the more uniform and favorable conditions of that region have favored the persistence of more primitive types without inducing the development of very advanced types

Compared with the four regions that are richest in endemics, the following regions have only one-third to one-half as many in each region · southwestern Europe, the Caucasus-Iran region, Abyssinia and adjacent small areas, and southeastern Asia One of these, the Abyssinian region, differs from the other four in having all the phyletic groups represented The ten endemics of the Abyssinian region are all montane except the two primitive species which are alpine, and yet four of these montane species are advanced It will be recalled, however, that certain other advanced species are montane This is true of the one 3-paired endemic, *C fuliginosa,* which occurs in southern Greece, and of its 4-paired close relative, *C cretica.* The three other regions contain only perennial endemics, none of which is advanced, some being intermediate and some primitive. Southwestern Europe and tropical Africa are important regions for the most primitive endemics since nine of the twenty-six endemics found in those two regions are classed as primitive-A Thus, at the western and southwestern extremes of distribution for *Crepis*, we find the greatest concentration of the most primitive endemics in the genus

In order to give another picture of the morphological contrasts between these most primitive endemics and the most advanced endemics in the genus, *C terglouensis,* an alpine species found only in the European Alps, is shown in fig 4, a–f, and *C fuliginosa,* a lower montane species of southern Greece, in fig. 4, a′–f′. The plants and their parts are all drawn at comparable scales. It will be noted that, in their haploid sets of chromosomes, the two species represent the extremes of variation found in *Crepis* in both number and size of the chromosomes.

With further reference to the chromosomes of fifty-three of the endemic species (Table 5), it is clear that the 6-paired endemics are restricted to regions I to IV except for one species, *C. kashmirica,* of northwestern India In fact

TABLE 5

RELATIONS BETWEEN THE ENDEMIC REGIONS FOR *Crepis* AND THE PHYLOGENETIC GROUP, ALTITUDE AND DURATION OF LIFE OF 133 ENDEMIC SPECIES, AND THE HAPLOID OR BASIC CHROMOSOME NUMBERS OF 53 OF THE SAME SPECIES

Endemic regions	Totals	Phylogenetic groups				Altitude classes			Duration classes		Chromosome numbers				
		Primitive		Inter-mediate	Ad-vanced	Alpine	Mon-tane	Low	Peren-nial	Annual or biennial	6	5	4	3	Totals
		A	B												
I S W Europe, Alps, N W. Morocco (mountains)	8	3	2	3		3	3	2	8		2	1	3		6
II Balkan Peninsula	26	2	3	14	7	6	13	7	19	7	4	3	6	1	14
III Asia Minor; Syria–Palestine, Crimea	18			10	8	6	3	9	10	8	1	1	6		8
IV Caucasus, Iran	13		5	8		5	5	3	13		1	1			2
V Turkestan—Pamir Altai region	6		3	3		3	3		6				1		1
VI N W India	3	1		1	1	2	1		2	1	1	1			2
VII S E Asia	9			9		1	8		9						
VIII E Siberia	1			1			1		1						
IX Japan	2	1		1		2			2				2		2
X Abyssinia, Eritrea, S W Arabia	8		2	3	3	2	6		6	2		1			1
XI. Africa (tropical and south)	18	6	1	11		1	11	6	18				2		2
XII Egypt to Morocco (littoral), Madeira and Canary Is , S Italy, S France	21			11	10		2	19	14	7		2	13		15
Totals	133	29		75	29	31	56	46	108	25	9	10	33	1	53

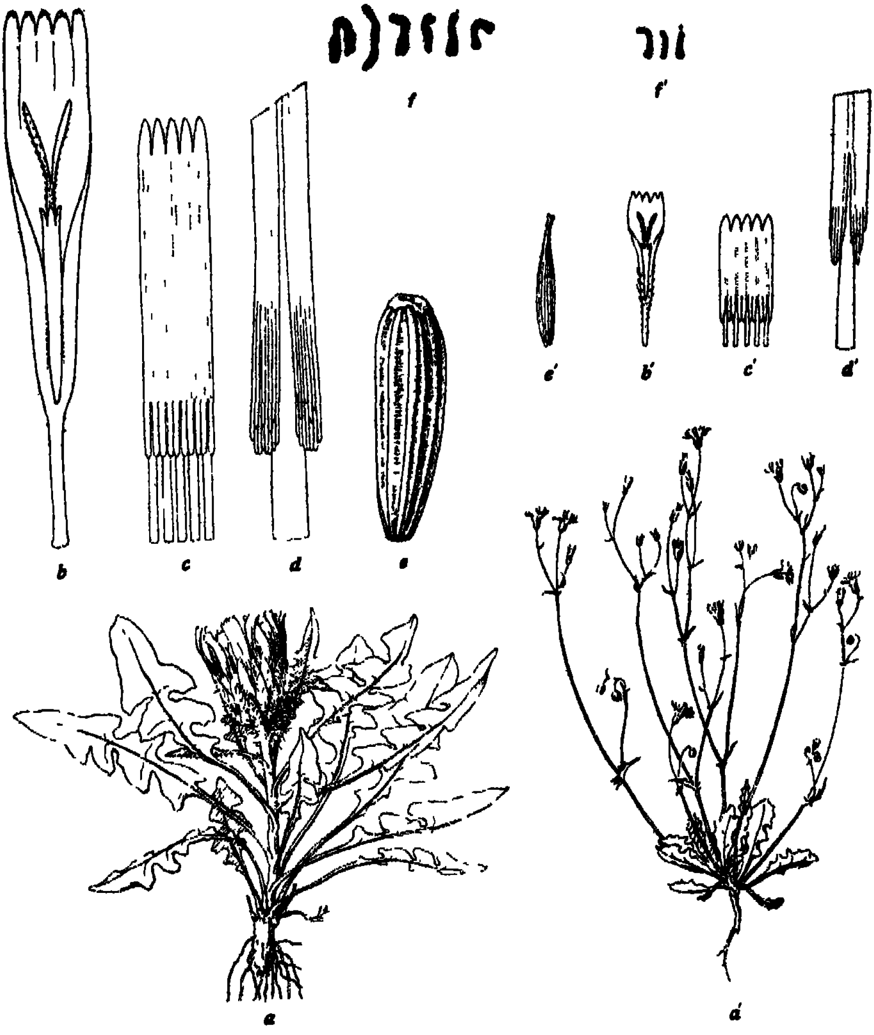

Fig 4 *a–f*, *Crepis terglouensis* (Hacq.) A. Kern *a*, plant, × ½, *b*, floret lacking the ovary, × 3; *c*, anther-tube slit and opened out, × 6, *d*, detail of anther appendages, × 24, *e*, achene, × 6, *f*, haploid set of chromosomes, × 925 *a′–f′*, *Crepis fuliginosa* S. et S. all as above

two-thirds of them occur in the mountains of southwestern Europe and the Balkan Peninsula. But the 5-paired endemics are widely distributed, and the 4-paired species still more widely, with a strong representation in the Mediterranean littoral. The evidence from chromosome numbers is consistent with the morphological evidence in showing that the oldest endemics are mostly in the mountains of southern Europe whereas the youngest endemics are mostly in the Mediterranean littoral and closely adjacent areas. This evidence from chromosome numbers supports the general hypothesis, based on morphology and geographic distribution in the genus as a whole, concerning the origin and distribution of the genus This hypothesis includes the assumption that two of the important causes of increased speciation in the genus were the climatic and topographic changes which occurred in southwestern Asia and the Mediterranean region during late Tertiary and early Quarternary time. In *Crepis* the endemic areas most affected by these changing conditions are 1 to 9, 21, 22 and 24 (cf fig 3)

V THE GENERAL SIGNIFICANCE OF ENDEMISM IN *CREPIS*

In addition to the support found in this study of endemism in *Crepis* for the hypothetical history of the genus which had been previously formulated, it appears that some of the evidence on *Crepis* endemics has a bearing on important problems of plant distribution One such problem concerns the so-called age and area hypothesis (Willis, 1940) which assumes that the age of a species or group is proportional to the area it occupies

The "age and area" concept From the foregoing review it is clear that among the endemic species of *Crepis* there are two extremely diverse groups (1) *the primitive, perennial, alpine endemics* which are relatively old, monomorphic, and adapted to mesophytic conditions, and (2) *the advanced, annual lowland endemics* which are relatively young, more highly variable, and adapted to xerophytic conditions

Now the present distribution of these two groups does not conform to the "age and area" concept The old, alpine endemics, however, are believed by most students of floristics to have been more widespread before the Pleistocene epoch and to have moved into the narrow niches that they now occupy from glacial refugia (Braun-Blanquet, 1923, pp 260–261) The fact that many of them are of relatively wide distribution, although they exist only in a special type of environment, supports this idea On the other hand, the young, lowland, annual endemics are just as widely distributed as the alpine species are at present, and there are a number of lowland, annual species, not endemics, for example, *C foetida* and *C pulchra*, which are about as widely distributed as the forerunners of the alpine endemics ever could have been. Hence the "age and area" concept breaks down completely with respect to these two groups of endemic species As has been pointed out by Stebbins (1942) the concepts of "senescence" and "competition" are no more satisfactory than "age and area" in attempting to account for such diverse groups of species. But the concept that the monomorphic, alpine species are genetically homogeneous whereas the variable lowland species are genetically heterogeneous, i e, composed of several or many biotypes, provides an acceptable explanation of their differences in variability and distribution.

The nature of the "narrow" Crepis endemics. This genetic approach to the problem of the differences between the widely distributed alpine and lowland endemics also provides a satisfactory explanation of the nature of the "narrow" *Crepis* endemics. Of the forty-eight Old World species which were classified as "narrow" many are known only from their type locality or else the information about their distribution is vague; but there are several concerning which it is possible to make fairly definite statements. These are listed below in their phylogenetic groups, together with pertinent data

NARROW ENDEMICS—ALL PRESUMABLY MONOMORPHIC

Primitive

1. *C kilimandscharica* O Hoffm Section 8 Known only from Mt Kilimanjaro at four stations, 2700–3500 meters, in forest
2. *C cameroonica* Babc Section 8. Known with certainty only from Mt Cameroon at three stations, 2000–4000 meters, in meadows

Intermediate

3. *C taygetica* Babc Section 10 Known from five collections, all made at a place called "Porta" at about 2300 meters altitude on Mt St Elias in the Taygetus Mts, of southern Greece Exposed rocks
4. *C crocifolia* Boiss et Heldr Section 10 Known from three or four collections made at a place called Megala Zonaria, at about 2400 meters altitude, on the same mountain as the preceding Exposed rocks
5. *C athoa* Boiss Section 10 Seven collections, all on Mt Athos, Hagion Oros Peninsula, northern Greece Exposed rocks

Advanced

6. *C eritreensis* Babc Section 20 Three or four localities in southern Eritrea from 800 to 1400 meters elevation One collection was from "a comparatively moist, rocky formation"
7. *C tybakiensis* Vierh Section 20 Known from one specimen, collected in southern Crete Since Crete has been botanized by numerous collectors, it is very probable that this species would be represented by more collections if it were widely distributed on the island. Certainly insular
8. *C divaricata* (Lowe) F Schultz Section 25 Known with certainty from four collections made on the isolated eastern promontory of Madeira Island where it has been nearly exterminated by grazing (Reported in 1837–1850 from the tiny Desertas Islands near Madeira.) Certainly insular
9. *C. Noronhaea* Babc Section 25. Six collections, all from Porto Santo, a small island in the Madeira Archipelago. Certainly insular.
10. *C Forskalii* Babc. Section 27. Two localities in Yemen Province, southwestern Arabia, between 1300 and 2500 meters elevation, in the coffee belt

It is noteworthy that three of these species, *C divaricata*, *C Noronhaea* and *C. tybakiensis*, are insular and of very restricted distribution However, they are relatively advanced species Therefore their morphological homogeneity (assuming that *C. tybakiensis* is actually monomorphic) must be due to genetic homogeneity rather than to senescence Five others in the above list, *C kilimandscharica*, *C. cameroonica*, *C taygetica*, *C crocifolia* and *C athoa*, are each found on only a single mountain They are almost certainly "depleted" species (Stebbins, 1942) and they probably became isolated through widespread changes in topography and climate during late Tertiary and Pleistocene times. In these also the population must be relatively small and homogeneous The other two species may also be "depleted" species, although it must be admitted that the available information on their distribution and variability is scanty

SUMMARY

1 The twelve endemic regions for *Crepis*, comprising twenty-five areas, define the east-west distribution of the genus almost completely.

2 Seventy-two per cent of the Old World *Crepis* species are endemic in the sense that they are restricted to a single subcontinental geographic area Among these endemic species are two very diverse groups, namely the most primitive, perennial species, half of which are alpine relics, and the advanced, annual species, most of which occur at low altitudes under arid conditions The remaining endemics comprise an intermediate series connecting these two extremes But comparatively few of the alpine perennials and of the lowland annuals have narrow distributions, i e, their distributional areas, as at present known, are mostly over 150 kilometers in extent From this evidence it is inferred that the alpine relics were formerly of wider distribution and that they moved into their present niches from glacial refugia, whereas the lowland, annual endemics have become adapted to a more arid climate but under conditions favoring genetic heterogeneity From the evidence on morphology and distribution as well as on chromosome numbers it is inferred that the process of adaptation from mesophytic to xerophytic conditions went on in the genus as a whole over a long period of time

3 The distribution of the most primitive and most advanced endemic species of *Crepis* supports the conclusion, derived from the evidence on phylogeny and distribution of the genus as a whole, that the center of origin was in Central Asia

4 The "age and area" concept of Willis breaks down completely in the light of the evidence on the two diverse groups of endemic species mentioned above

5 The concept of "senescence" fails to explain the existence of narrow endemics in *Crepis* since this group includes some of the most primitive and most advanced species in the genus Since they are either insular or terrestrial, "depleted" species, the population is more or less restricted in size and relatively homogeneous

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NICOTIANA ARENTSII—A NEW, NATURALLY OCCURRING AMPHIDIPLOID, SPECIES

BY

T H GOODSPEED

Department of Botany
University of California[*]

In 1917, Winge pointed out that the arithmetic progression observed in the chromosome numbers of some genera might be the product of interspecific hybridization followed by chromosome doubling. Eight years later, Clausen and Goodspeed showed that such doubling had occurred in a fertile F_1 hybrid between *Nicotiana glutinosa* and *N Tabacum*. This initial verification of Winge's hypothesis served to direct interest toward the incidence, causes and artificial induction of amphidiploidy (cf Goodspeed and Bradley, 1942) It also led to an evaluation of the applicability of Winge's hypothesis in picturing evolutionary relationships in the genus *Nicotiana*

Fundamentally, *Nicotiana* is a New World genus and, with the exception of 5 species showing 9 or 10 pairs of chromosomes, all its North and South American species possess either 12 or 24 pairs. Since there is no evidence that any of the 24-paired species is autopolyploid, it has been assumed that they were amphidiploid in origin (Goodspeed, 1934). Proof of such origin would contribute materially to the systematic botany of the genus and to an interpretation of its species distribution in the two Americas. For two of the 24-paired species, such proof is at hand. Thus, *N Tabacum* ($n = 24$) has been shown to be an amphidiploid product of hybridization between progenitors of the modern species *N sylvestris* (n = 12) and *N tomentosa* (n = 12) or its relatives (Goodspeed and Clausen, 1928) These two species are peculiar to the Andes of Peru, Bolivia, or Argentina, and one of the products of the three University of California Botanical Garden Expeditions to the Andes has been the demonstration that today the distribution of the putative parental species overlaps Similarly, progenitors of two other present day Peruvian-Bolivian-Argentine species, *N paniculata* (n=12) and *N undulata* (n=12), were undoubtedly the parents of the amphidiploid species *N rustica,* the other well-known 24-paired species of commerce (Goodspeed, 1934, 1936).

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Despite cytogenetic evidence in favor of amphidiploid origin, it has not been possible to reproduce artificially a duplicate of modern *N Tabacum,* or of *N rustica,* nor is there evidence of the existence of at least the former species in a wild state In other words, although there is good reason to believe that the 24-paired American species of *Nicotiana* are of amphidiploid origin and while amphidiploidy has been induced in at least 27 experimentally produced F_1 interspecific hybrids (Bradley and Goodspeed, 1943), no naturally occurring American species has hitherto been found for which such origin could be shown [1] It now appears that the recently discovered *N Arentsii* is such a species

In November 1938 one of the members of the Second University of California Botanical Garden Expedition to the Andes, Dr César Vargas C , Professor of Botany and Director of the Botanical Museum in the University of Cuzco, Peru, found *N Arentsii* in southeastern Peru, north of Lake Titicaca, near the Bolivian border, in and about the village of Limbani, Limbani is situated in the Dept Puno, Prov Sandia, at an altitude of about 3500 m , in a narrow box canyon on the eastern watershed of the Cordillera The region is remote, climatically inhospitable, and little known botanically Nearby, at somewhat lower altitudes, is the beginning of the Amazonian rain forest The following extract from Dr Vargas' notes is included here, in part because of its general botanical interest Below Limbani, "the river of the same name runs swiftly and precipitately, a turbulent and foam-flecked stream which springs from the thawing snows of the nearby Cordillera. The village mostly consists of hovels and cabins nearly all made of whitish granitic rock with roofs of straw The only street is the tortuous highway, lined on both sides by the principal habitations while the rest are scattered here and there on contiguous slopes On the walls of the canyon are a series of shelves or terraces, now in ruins Nobody knows how many hundreds of years ago they were constructed through the laboriousness and perseverance of a people who disappeared long ago and for whom the soil and the plant constituted the most cherished gifts of nature. However, what is most cheering is the abundance of vegetation . . . herbaceous and shrub forms as far as my eyes reach; even the rocky cliffs offer a varied flora. Along the road there are found several species of the families *Melastomaceae, Ericaceae, Campanulaceae,* etc. . . beautiful and graceful clusters of *Bomarea* hang among *Baccharis, Cantua,* and other bushes; under the rocks and on the demolished terraces grow two species of *Begonia, Solanum, Centropogon, Monnina* and, in the dank turf, species of *Viola* and *Calceolaria*. The air was humid, the soil moist." The Quechua name for the new *Nicotiana* species was "Cjamasairi."

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[1] Kostoff (1939) has commented upon the origin of a 32-paired race of the Australian species *N suaveolens* (n=16) or its close relatives which was first grown in the University of California Botanical Garden (Wheeler, 1935). For this race Kostoff has suggested the name *N Eastii* (but does not formally describe it as a new species) and considers it an amphidiploid product of hybridization between *N. suaveolens* and *N. maritima* We have grown more than one 32-paired race from Australia and their morphological distinctions appear to complicate the problem somewhat.

Four years later, Mr. Roy D. Metcalf, a member of the Third University of California Botanical Garden Expedition to the Andes, during an exploration of the Inambari and Tambopata drainage basins, collected *N. Arentsii* again. He found it restricted to the immediate vicinity of the village of Limbani and commonly around habitations, in some cases growing on walls and fences. According to his report, it prefers semi-shade, moist but not wet surroundings and gravelly soil among rocks. The preference of *N. Arentsii* for disturbed ground and the partial protection provided by habitations is characteristic of many South American species of *Nicotiana*. In Limbani the Indians did not make any use of the plant. Although Mr. Metcalf's itinerary northward from Chucuito (Dept. and Prov. Puno) at the northwest end of Lake Titicaca, took him as far as the Santo Domingo mine (immediately north of the Inambari river) in the province of Sandia and as far east as the towns of Sandia and Cuyocuyo, he did not again encounter this species. He states that *N. undulata* was also called Cjamasairi by the natives.

From the original seed of *N. Arentsii* collected by Dr. Vargas, 100 plants have been grown in the University of California Botanical Garden at Berkeley, California. Of these, 25 were grown in 1940, 75 in 1941. In the former year, all plants were set out in open ground; in the latter year, 35 were planted out, 38 held outdoors in large pots, and two allowed to flower in pots in the greenhouse. Potted plants from seed sown on January 10, 1941, began to bloom August 28, 1941. Those plants transplanted to open ground from seed sown on February 16, 1940, and January 10, 1941, began to bloom in the middle of the next October. To test their reported perennial capacities the field culture was not discarded at the close of the 1940 growing season. Although the winter (of 1940) was moderate in temperature, the plants died after setting seed. All plants held in large pots failed to develop lower branches. Their inflorescences were narrower than those of field plants. Finally, plants blooming in the greenhouse lacked the rose-red pigmentation in calyx and corolla, characteristic of field grown plants.

In all these garden cultures the branching was variable and frequently asymetric. There was also a strong tendency toward fasciation of elements of the inflorescence. Generally, the union did not extend beyond the first leaf of the axillary shoot. The branch thus affected would depart from the main axis at a decidedly more acute angle than that of a normal shoot. Fasciation did not appear in a population of 13 plants grown, under equivalent conditions, in 1943 from selfed seed of a 1942 plant. Despite certain definite but intergrading variations in leaf shape and inflorescence type, the appearance of the original populations was as uniform as might be expected from seed of wild plants.

On the basis of herbarium and garden studies, *N. Arentsii*[5] was found clearly to combine prominent morphological features of two other species of *Nicotiana*—i.e., *N. wigandioides* Koch and Fint. and *N. undulata* R. and P. The former is a subarborescent species, less massive than *N. tomentosa* but attaining a height of several meters and capable of living a number of years in the Berkeley climate. Especially on younger stem parts, long straight silvery hairs stand out prominently, there being, however, a glabrous region below the insertion of the leaf. The length, and to some degree the direction, of these soft, glistening hairs is modified in *N. Arentsii*. The red-purple coloration of *N. Arentsii* manifested in stem, leaf, calyx, and a pinkish blush to the corolla is derived from *N. wigandioides*. Plants of both species blossoming in the greenhouse instead of outdoors, lack it. Slow maturing, despite early sowing, is characteristic of both. *N. undulata* on the other hand, contributes to *N. Arentsii* relatively low stature and annual to limited perennial habit, greater leafiness in the inflorescence region, and a large adaxial calyx lobe. In certain plants it modifies the calyx coloration to a blue-black.

Generally speaking, *N. wigandioides* is a tropical or subtropical species as yet known only from central (western) Bolivia. It may be associated with the eastern headwaters of the Beni river for it has been collected a short distance beyond the edge of this drainage system (*Cárdenas* 2800, Inca Corral, Dept. Cochabamba, Prov. Chapare, 1700 m.; *Steinbach* 5754, Cerro de Incachaca, Dept. Cochabamba, Prov. Sacaba,[6] 2500 m.) and well within it in valleys in Dept. La Paz (*Rusby* 75a, Mulford Biol. Explor. Amazon Basin, Cañamina, Prov. Inquisivi, 1100 m., *Troll* 2812, Lambate, Prov. Sud Yungas, 3400 m.; *Buchtien* 3905, Unduavi, Prov. Nor Yungas, 3200 m.; *Rusby* 2434, near Yungas, 1200 m.). It may also occur to the north and it is unfortunate that we have been unable to explore the tributaries of the Rio Beni in Bolivian territory adjacent to the Peruvian area where *N. Arentsii* was found.

Speaking of the vegetation at his last cited locality, H. H. Rusby (1888, p. 181) writes: "Descending to 7000 feet, we enter the great Andean forests which become heavier and heavier, though scarcely denser, as we descend. The trunks and greater branches are scarcely to be seen for the epiphytes upon them, chief of which are orchids, bromeliads, ferns, mosses, and aroids. At 5500 feet, we strike the coca and cinchona belt, and at 4000 feet we find the heat becoming oppressive and the air sultry. From 3500 to 5500 feet is probably the region of greatest rain-fall " Beyond general pictures such as this there is little description of habitat for *N wigandioides* except the remarks of Dr. Martin Cárdenas on his collection of this species from Inca Corral. He refers to the region as "Ceja de Monte; the 'Ceja' is a kind of beginning of the Yungas " The term Yungas is used here as a collective designation for Bolivian tropical valley terrain He states that *N wigandioides* grows "on wet soil "

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[5] A detailed description of this new species appears at the end of this report where photographs of it and of *N. undulata* and *N. wigandioides* will be found.

[6] Undoubtedly a mistake and should read "the cánton of Sacaba, in Prov. Chapare."

N undulata is a widely distributed species which, by contrast, thrives in high, cold, bleak situations and generally fails to compete successfully as the climate becomes less rigorous and the region can support a richer vegetation Apparently, it does not descend the eastern flank of the Andes but everywhere finds a congenial habitat in the Puna zone to the west. Its range is continuous from northern Argentina (Univ Calif Bot Gard. Exped Andes 6323, coll *West*, 20 km w of Humahuaca, Prov Jujuy, 3600 m) to central Peru (Univ Calif Second Bot Gard Exped Andes 10985, coll *Stork*, Muilo, 10 km w of Tarma, Dept Junin, 3300 m) and it has even been found in northern Peru (Univ. Calif Third Bot Gard Exped Andes 30781, coll *Metcalf*, road from Cajamarca, 3200 m) Near Oroya, Peru, it forms almost pure colonies where only it and *Bidens* can tolerate the fumes from nearby smelters (Univ Calif Second Bot Gard Exped Andes 10986, coll *Stork*), between Candarave and Puno it occurs in the hard-packed roadbed (Univ Calif Third Bot Gard Exped Andes 30387, coll *Metcalf*), in Chucuito, Huancane, Putina, Asillo and other windswept altiplano towns of the Dept Puno (*ibid* 30677, 30704, 30718, 30424) it is common in the streets, on refuse dumps, and in the protection of houses and fences Metcalf reports. "While crossing the altiplano, the one plant that one expects to find is this Nicotiana When there is nothing else, there is always this while never growing in great abundance in any one site, it none the less covers sparsely huge areas. Roughly, *N undulata* occurs from 10,000 feet to over 14,000 feet "

Although *N wigandioides* has not been found near the limited known range of distribution of *N. Arentsii*, the other species, *N undulata*, which appears to have entered into its amphidiploid origin, occurs within 30 km. of it In the La Paz region of Bolivia, *N undulata* and *N wigandioides* have been collected within this distance and in Dept Cochabamba they are found within 10 km. of each other It is, therefore, not too much to say that in past time these two species have been in contact, if they are not so at present In the dissected eastern edge of the Peruvian-Bolivian Andes, alps and tropics are remarkably juxtaposed and wherever a cleared pathway opens, whether it be by diastrophic movement, streams, or man-made paths, *Nicotiana* species will seek to colonize the disturbed ground to the limit of their climatic tolerance.

Above, it has been pointed out that *N. Arentsii* is morphologically a mosaic of the distinctive characters peculiar to two other species of *Nicotiana*. Attention has also been called to the fact that, at one time, the range of distribution of these two species undoubtedly overlapped and that today one of them is known to be practically in contact with *N. Arentsii* These two lines of evidence suggest that this new species originated as a hybrid between progenitors of the two other species, chromosome doubling then occurring in the hybrid The following cytogenetic observations largely confirm this suggestion.

It is, first, to be noted that the chromosome number of *N. Arentsii* is 24 pairs while both *N undulata* and *N wigandioides* possess 12 pairs. In an earlier report (Goodspeed 1934), it was shown that the somatic karyotype of *N undulata* consists of chromosomes with median or submedian centromere, one of the submedian pairs satellited In the case of *N wigandioides* there are 8 pairs with median or submedian centromere and 4 with subterminal, one of the subterminal satellited As regards size, there is little difference between the two complements, less, indeed, than between the largest and smallest chromosomes within a complement Both karyotypes belong to the larger, but not the largest chromosome size groups in the genus Detailed study of its chromosome morphology shows that the complement of *N Arentsii* represents a summation of the two species types, with mostly median or submedian centromere but a few with subterminal The scant size distinctions between the *N undulata* and *N wigandioides* complements do not, however, make it feasible to homologize full complements but it may be said that the morphological equivalents of the satellited pair characteristic of each of the two species has been identified in *N Arentsii*

Meiotic configurations (pollen mother cells) of each of the three species were studied to determine whether any characteristic *N undulata* or *N. wigandioides* features reappear in *N Arentsii* In each of the 12-paired species, two IM bivalent types were selected as sufficiently distinctive to be identified in *N undulata* (1) a completely terminalized one-chiasma bivalent with oblong partners and (2) a completely terminalized thick ring bivalent, in *N wigandioides* (1) an incompletely terminalized one-chiasma bivalent in which two droplet partners are separated by a central (generally small) bead and (2) a not quite terminalized, two-chiasma "diamond" bivalent Each of these types reappeared in *N Arentsii*

In *N undulata* and *N wigandioides*, meiotic chromosome behavior is normal but in *N Arentsii* pairing was sometimes found to be irregular, even in plants which produced only good pollen grains It is not possible to say that this condition prevailed in every plant, as only a few were examined in first metaphase, but the fact that it was true of every plant examined is significant. It was noted that from 2 to 6 chromosomes (often in more than 50 per cent of the PMC) either failed to pair or formed trivalents. In 20 second metaphase counts of one plant, this irregularity reduced to 85 per cent the PMC showing 24–24 distribution of chromosomes, the remaining 15 per cent showing 23–25

Beyond a determination of chromosome number, the cytology of *N Arentsii* had not been studied at the time hybrids of this new species with *N. undulata* and *N wigandioides* were made and grown A few plants each of both F_1 hybrids were secured and inasmuch as the preponderance of meiotic material available proved to be from monosomic hybrids made with the same *N Arentsii* parent, it is clear that the particular *N Arentsii* plant involved in the crosses was itself monosomic Apart from somewhat complicating the determination of extent of pairing, this situation did not alter the essential evidence, briefly summarized as follows

F₁ Hybrid	PMC counted	Plant number	Chromosome Constitution	Pairs per PMC Range	Pairs per PMC Average
N undulata × *N Arentsii*	14	F-341 P54	36	11–12	11.71
	25	F-385 P51	35	11–13	11 96
N Arentsii × *N wigandioides*	25	F-386 P55	36	11–13	11.92
	25	F-386 P58	35	11–13	12 08
	25	F-386 P59	35	11–13	11 96

In the case of F₁ *N Arentsii* × *N wigandioides*, somewhat more than 50 per cent of the counts represent 12 bivalents only The remainder involve combinations ranging from $8_{II} + 3_{III}$ to 13_{II} with the largest class $10_{II} + 1_{IV}$ and the next $11_{II} + 1_{III}$ Almost the same types of association occurred in the case of F₁ *N undulata* × *N Arentsii* except that the proportion of 12_{II} was approximately 40 per cent In view of the extent of multivalent formation in the two hybrids just mentioned, the occurrence of some pairing in the hybrid which represents the third side of the triangle, F₁ *N undulata* × *N wigandioides*, was not unexpected Thus, a range of from 2 to 9 pairs was observed in 100 pollen mother cells while the average number of pairs was approximately 5

For our present purpose, it is sufficient to call attention to the fact that the cytogenetic evidence shows that the gametic sets of both *N. undulata* and *N wigandioides* are represented by a full set of homologous chromosomes in the gametic set of *N Arentsii* and that the amount of pairing in F₁ *N undulata* × *N wigandioides* is low In other words, the cytogenetic findings are consistent with the evidence from external morphology and from distribution which indicate that *N Arentsii* represents an amphidiploid product of hybridization between those other two species of *Nicotiana*

Nicotiana Arentsii Goodspeed, sp nov

Nicotiana herbacea, caule crasso, conspicue pubescente, foliis petiolatis, late ellipticis, rotundo-ovatis vel subcordatis; floribus in paniculas foliosas dispositis, calyce magno, lobis inaequalibus; corolla dilute straminea v prope alba, obconico-clavata, limbo plus minusve zygomorpho, lobis obtusis, staminibus inclusis, abrupte curvatis, ad partem tubulatam corollae inferne affixis.

Type —University of California Second Botanical Garden Expedition to the Andes, 1938–39, 9666 (U C Herbarium 665156) Coll C Vargas C , Nov 21, 1938, **Limbani, Dept. Puno, Prov Sandia, Peru.** Alt. 3400 m Close to the road and houses "Cjamasairi" *Other authentic material* University of California Third Botanical Garden Expedition to the Andes, 1942–43, 30529 Coll R D. Metcalf, May 16, 1942, in town of Limbani, Dept Puno, Prov Sandia, Peru Alongside huts, north end of town Alt. 3350 m

Slowly maturing annual or limited perennial 1–2 m. high Stem commonly reddish purplish, rather densely clothed with distinct but not long, weak, silvery-white hairs, ultimately oldest parts glabrate, thinly corky, woody within; main axis stiffly erect, 2–2 cm. thick, chief branches few, irregular in length and distribution, usually some long and rapidly ascending. Leaves pubescent; blade to 25 or 30 cm. long and about 20 cm. wide, rotund-ovate or subcordate or the uppermost often lance-ovate, base variable, apex acute or acuminate, veins evident, sometimes indenting upper surface a little, margin slightly undulate, petiole $\frac{3}{8}$–$\frac{1}{10}$ as long as blade, frequently red coloration in petiole, midrib, veins, margin or even hairs. Inflorescence paniculate, 35–50 cm. long, narrow or broad, lower limits indistinct by very gradual reduction of leaves to sessile, broadly lanceolate bracts, central axis erect, thick, pubescent but seldom viscid; laterals numerous, frequently rather crowded, variable in length, generally rigid and spreading, paniculately or occasionally cymosely branched, ± viscid; ultimate pedicels about 2 mm. long, later 6 mm. Flowers abundant, odorless or nearly so. Calyx green, green suffused with red-purple, or green blended with blue-black, pubescent, 10–14 mm. long, broadly cylindric or subcampanulate, membranous area below each sinus narrow, short, lobes shorter than tube, broadly triangular-ovate, plane, unequal, largest never extending to corolla mouth. Corolla distinctly pubescent exteriorly except in the partially glabrous limb, tubular part 15–20 mm. long, 7–9 mm. wide, broadly obconic from short, narrower base, apically somewhat swollen immediately below the slightly contracted mouth, pale greenish yellow with pink or purplish tingeing above; entire limb (including rimmed, hexagonal mouth) to 17 mm. across, in bud spirally plicate and often bright pink, in flower spreading, pale straw color frequently conspicuously suffused with pink outside, rarely also some pink inside, lobes broad, obtuse, 3 upper ones smaller, commonly a little deflexed. Stamens inserted about 5 mm. from very base of corolla (at or near where the obconical expansion begins), filaments thick, pale greenish, 4 equal or subequal, wooly and erect for several mm. above insertion, then glabrous and curving outward abruptly to rest against corolla, extending to about 1 mm. below corolla mouth, 1 sigmoid, not wooly above insertion, commonly appearing somewhat shorter; anthers yellow-green. Pollen pale straw color. Hypogynous disk thick, red or red-orange. Ovary rotund-ovoid, greenish or purplish; style thick, faintly greenish, stigma green, discoid-pulvinate, median groove shallow. Capsule included, 7–9 mm. long, elliptic-ovoid, brown, on dehiscence upper half split into 2 divergent, notched valves. Seeds broadly elliptic-ovoid, 0.7–0.8 mm. long, rather dark brown, surface shallowly reticulate, meshes moderately large, deeply lobed by bounding ridges, embryo straight. Somatic chromosome number 48.

Distinguishable from *N. undulata* R. & P. by later maturity; longer, more distinct, glistening hairs; larger, rotund-ovate leaf; larger flower, longest calyx lobe plane, not boat-shaped in flower or fruit, corolla limb sometimes pinkish, never greenish; from *N. wigandioides* Koch & Fint. by shorter life span, smaller leaf; markedly unequal calyx segments; smaller corolla limb.

Named in honor of Mr. George Arents, to whom botany is indebted for a comprehensive compilation of the history and culture of tobacco.

SUMMARY

A new species of *Nicotiana, N Arentsii* (n = 24), from southeastern Peru is described, with comments upon its morphology, distribution and cytology Similar comments are made in the case of two other *Nicotiana* species, natives of Peru and Bolivia—*N. undulata* (n = 12) and *N wigandioides* (n = 12). The morphological and distributional evidence points to an amphidiploid origin for *N. Arentsii* in which the other two species are involved. This hypothesis is confirmed by the cytology of the three species and of the F_1 hybrids made between them

(Since the above was written, it has been possible to reëxamine the herbarium material of two Bolivian collections of H H. Rusby which, before *Nicotiana Arentsii* was recognized, were identified as *N wigandioides*. It is now clear that they were taken from plants of *N. Arentsii* Both are Rusby's No 822 and both are from Mapiri (Dept La Paz, Prov Larecaja) but one is labelled "5000 ft, April, 1886" and the other "2500 ft, May, 1886" Mapiri is approximately 200 km southeast of the Limbani area in which the collections of *N Arentsii* described above were obtained.)

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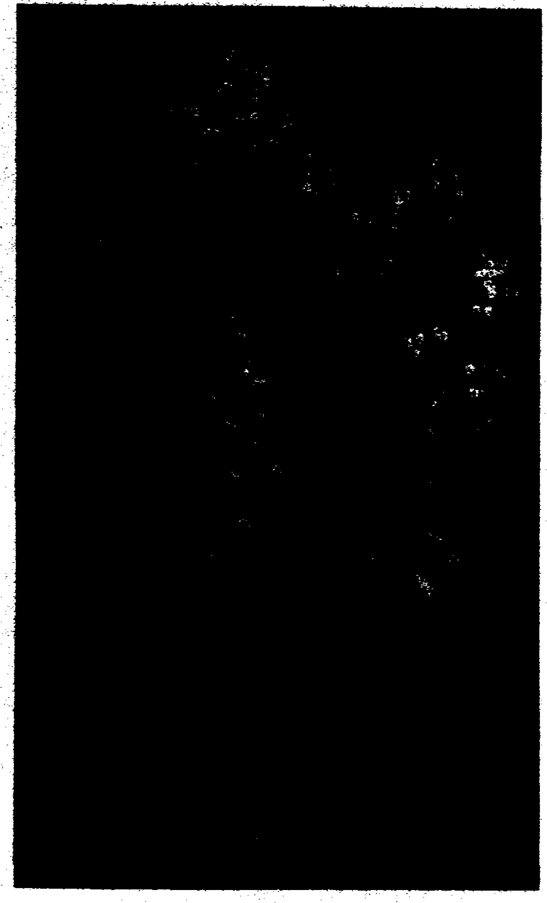
EXPLANATION OF PLATES

PLATE 26

Left *Nicotiana Arentsii*, **grown from seed of Univ. Calif. Second Bot Gard. Exped Andes 9666, Limbani, Dept Puno, Peru, coll. C. Vargas C**

Center: *N undulata*, **grown from seed of Univ Calif. Bot. Gard. Exped. Andes 7173, Pisaco, Dept Cuzco, Peru, coll James West.**

Right. *N wigandioides*, **grown from seed collected by José Steinbach, near Cochabamba, Bolivia**



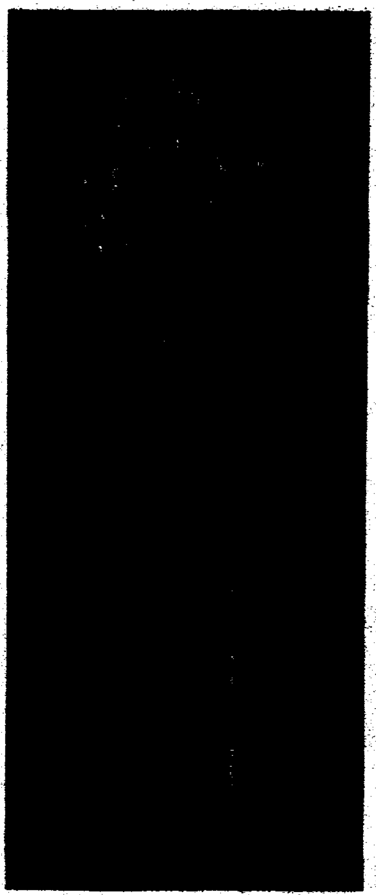


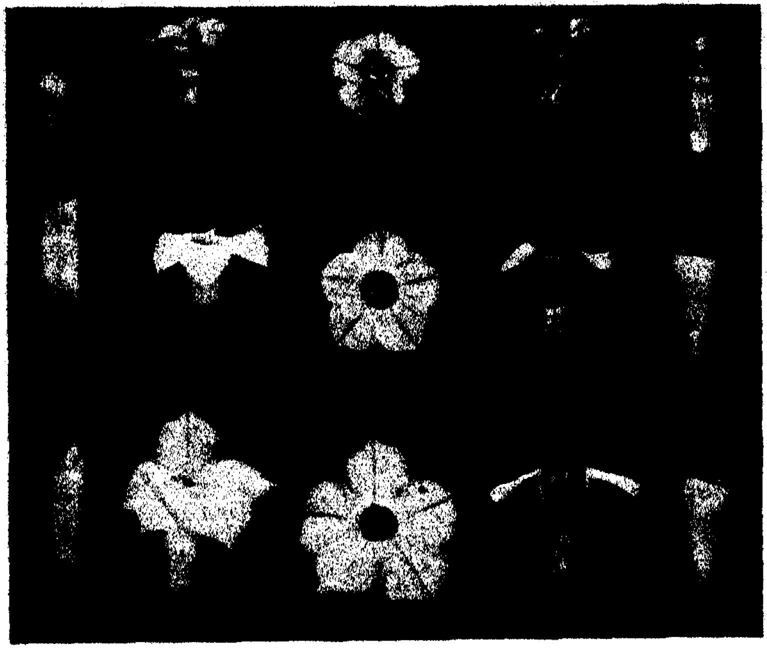
PLATE 27

Upper row: *Nicotiana undulata,* from seed collected by A. Weberbauer, at Huancavelica, Peru. The species is polymorphic in corolla shape and size. The race figured is relatively large flowered with the tubular part of its corolla broad and little dilated below the mouth.

Middle row: *N. Arentsii,* source as in plate 26.

Lower row: *N. wigandioides,* source as in plate 26.

(Black paper has been inserted in the corolla tubes of the sectioned flowers and one or two stamens removed to show the pistil. In *N. undulata* and *N. Arentsii* those removed included a short stamen, in *N. wigandioides* the two removed are no shorter than those remaining.)



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ALICE EASTWOOD SEMI-CENTENNIAL PUBLICATIONS

No. 13

THE CYTOGENETICS OF HYBRIDS IN BROMUS II. BROMUS CARINATUS AND BROMUS ARIZONICUS

BY
G. L STEBBINS JR, H A TOBGY, AND JACK R HARLAN
University of California

INTRODUCTION

THE FACT that *Bromus carinatus* H and A and its relatives constitute a complex of polyploid entities, mostly if not entirely of allopolyploid or hybrid origin, has been brought out in the first paper of this series (Stebbins and Tobgy, 1944) In an earlier survey of chromosome numbers (Stebbins and Love, 1941) the octoploid number of chromosomes (2n=56) was counted in all representatives of this complex collected in California Counts made by us of collections from Oregon, Washington, Idaho and British Columbia have revealed the same number, so that we can state with some assurance that the Pacific Coast members of this complex are predominantly if not entirely octoploid, with the exception of a type originally collected by one of us (Harlan) in Central Arizona. The 28 collections of the *B carinatus* complex made in this state were found to be divided into two series on the basis of morphological and ecological characteristics The first series, found mostly in desert washes, roadsides, and waste places at lower altitudes consists of strictly annual plants with relatively long awns; while the second, found predominantly at altitudes of 5000 feet (1500 meters) or higher, consists of perennials, with broad glumes; usually many-flowered spikelets, and shorter awns. The first series agree with the original description of *B carinatus* var. *arizonicus* Shear (1900), and would be identified as *B carinatus* according to the key of Swallen (1942) in the Arizona flora of Kearney and Peebles The second, since all but one of the specimens collected have essentially glabrous foliage, would be considered *B polyanthus* Shear, according to the treatment of Swallen (*loc cit*) Chromosome counts on five different collections of this second series revealed 56 chromosomes in them, as in Pacific Coast members of the complex A detailed description of one collection of it (no 116), with an account of its crossing relationships with other octoploid species, is presented elsewhere (Stebbins and Tobgy, 1944)

The annual, long-awned series, on the other hand, was found to possess uniformly the somatic number 2n=84, or 42 bivalents at meiosis, in material from 21 different collections (see map, fig 4). Furthermore, the same chromosome number was found in a similar annual form from Tehachapi, Kern County, California When these duodecaploids were grown in the same field at Berkeley along with a large series of octoploids from California as well as Arizona, it was found that certain morphological characteristics made them readily distinguishable from the perennial or subperennial, long-awned octoploid types from lower altitudes in California, as well as from the short-awned octoploids found at higher altitudes in both states For this reason, the specific distinctness of the 84-chromosome type was suspected, and the testing of this hypothesis by means of hybridization seemed desirable The results of this hybridization and their implications in regard to the status and possible origin of the 84-chromosome type are here presented

MATERIAL AND METHODS

Seeds from the Arizona collections were all planted in the field in the summer of 1941 Although each progeny from a single collection was with a few exceptions remarkably uniform, there was a great deal of variation between collections (Harlan, in press) Some of the seedlings behaved like desert ephemerals, producing only one or two tillers, which flowered in a few weeks when only 10 or 15 cm high, and produced only 2 or 3 spikelets, dying when the seed matured Others behaved like winter annuals, and in the spring produced very tall plants with several tillers and large panicles It was from one of the latter type that the parent stock for hybridization with octoploid *B carinatus* was selected The particular collection, no 125, came from south of Lake Meade, near Boulder Dam, Mojave County The octoploid strain used for hybridization was a typical *B carinatus* strain from Berkeley, represented in the University of California Herbarium by the collection Stebbins no 2677, and described elsewhere as strain no 5 (Harlan, in press; Stebbins and Tobgy, 1944) The hybridization was made in the field in May 1942, by Mr Henry Moser, according to the method described earlier (Stebbins and Tobgy, *loc. cit*) The cytological techniques used are described in the same paper

MORPHOLOGY AND SYSTEMATIC DESCRIPTION OF THE SPECIES AND THE HYBRID

The morphological and cytological data presented below leaves no doubt that the 84-chromosome type is a species sharply distinct from any now recognized in the *B. carinatus* complex, even though its diagnostic characteristics are somewhat meager. Therefore, a taxonomic description of it will be given at the outset, so that it may thereafter be referred to by its correct name Although the type specimen of Shear's *B. carinatus* var *arizonicus* has not been seen, and the original description is somewhat scanty, nevertheless there is little doubt that it belongs to the 84-chromosome species described here All of the collections made by Harlan from situations similar to Tucson, its type locality, are of this species, and it is the only member of the complex known from lower altitudes in Arizona One collection, no 105, in which 84 chromosomes were counted, came from the Santa Cruz Valley only 35 miles from the type locality *It may be described as follows (the taxonomic section is the* work of the senior author)

Bromus arizonicus (Shear) Stebbins n comb

Planta annua, culmi humiles vel alti, paniculae parvae spiculis paucis, vel ampla spiculis numerosis; glumae elongatae, secunda infimam lemmam aequans, lemmata ad marginem hirsuta, dorso scabra vel glabra, lemmata superiores conspicue bidentata

Plants annual, culms 15–140 cm high, with 3–5 nodes Leaves somewhat glaucous, glabrous or pubescent Panicle sometimes much reduced, but in well developed plants ample, the branches spreading, in groups of 5–6 at the lower nodes, the longest bearing 5–8 spikelets, branches often finely hirsute, the hairs more slender than in *B carinatus* Spikelets mostly 5–7 flowered, glumes subequal or distinctly unequal, *elongate, the upper glume about equalling in length the lowest lemma* Lemmas of medium length, mostly 11–14 mm long, *sparsely or densely hirsute near the edges, short-scabrous on the back, bidentate, the teeth rather prominent, those of the upper lemmas often with the lateral nerves extending into them*

Bromus carinatus var *arizonicus* Shear, U S Div. Agrost, Bull no 23 · 62.1900 Type in the U S National Herbarium, from near Tucson, Arizona, *C G. Pringle* in 1884 *B carinatus californicus* Shear, U S Dept Agr Div Agrost Bull 23 60, at least in part

Central and southern Arizona to southern and central California, in desert areas and open, disturbed ground of valleys; an introduced weed in the northwestern portion of its present range. The following specimens, in the herbaria of the University of California (UC) and the California Academy of Sciences (CAS), are typical. CALIFORNIA. Mark West Creek, *Bolander* 3985 (UC); Davis, Yolo County, *Stebbins* 3356 (UC), Alcalde, Fresno County, *Eastwood* 13492 (CAS); Tulare, *Davy* 3055 (CAS), Kettleman City, Kings County,

Hoover 442 (UC) ; Bakersfield, Kern County, *Davy* 1896 (UC) ; San Emigdio Cañon, Kern County, *Davy* 1985 (UC) ; Tehachapi, Kern County, *Harlan* 128 (UC) , Paso Robles, San Luis Obispo County, *Barber* in 1900 (UC) ; Santa Maria, Santa Barbara County, *Eastwood* 344 (CAS) , Pasadena, Los Angeles County, *Grant* 117, 117a (UC, CAS) ; Claremont, Los Angeles County, *Davy* in 1902 (UC) , San Bernardino, *Parish* in 1889 (UC) , Colorado Desert, Riverside County, *Hall* 5980 (CAS) , Fall Brook, San Diego County, *Jones* 3108 (CAS) , San Diego, *Orcutt* 1178 (UC) , between Del Mar and Lower California, *Lemmon* in 1888 (CAS) , Santa Catalina Id., *Brandegee* in 1890 (UC) , Santa Cruz Id , *Brandegee* in 1888 (UC) ; Santa Rosa Id , *Hoffmann* in 1929 (CAS) , San Clemente Id , *Murbarger* 56 (UC) , San Nicolas Id , *J T. Howell* 8226 (CAS) BAJA CALIFORNIA San Quintin, *Epling and Stewart* in 1936 (CAS) , 24 3 miles east of Rosario, *Wiggins* 5291 (UC, CAS). ARIZONA Wickenburg, Maricopa County, *W W. Jones* in 1921 (UC) ; Tempe, Maricopa County, *Gillespie* 5519 (UC) ; Fort Lowell, *Thornber* 535 (UC) , 25 miles southeast of Lake Meade, Mohave County, *Harlan* 125 (UC) ; east of Kingman, Mohave County, *Harlan* 128 (UC) ; Pinal Mts , southwest of Globe, Gila County, *Harlan* 112 (UC) , Salt River Canyon, Gila County, *Harlan* 115 (UC) ; Sacaton, Pinal County, *Harlan* 108 (UC) ; east of Flor-

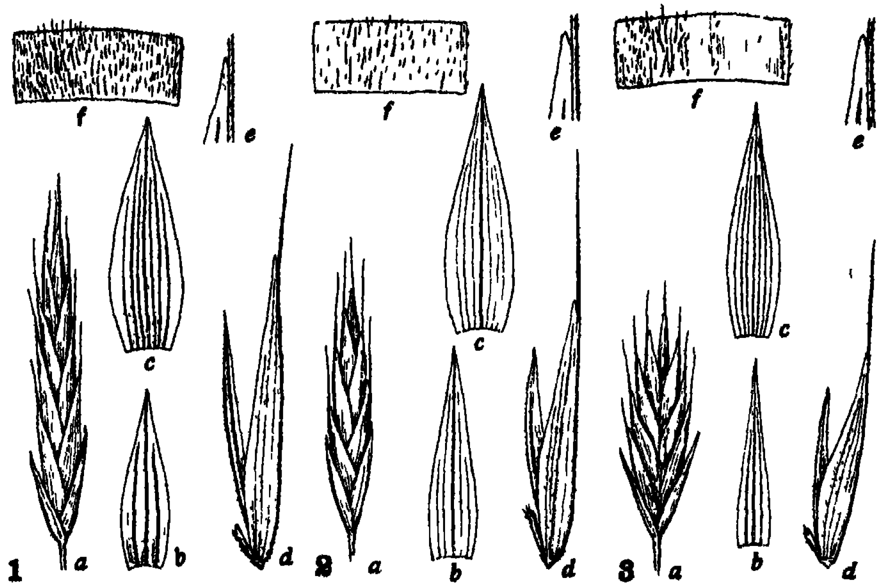


Fig 1 *Bromus carinatus*, strain no 5
Fig 2 *Bromus arizonicus* × *carinatus*, no 306 5
Fig 3 *Bromus arizonicus*, no 311 1 (progeny of Harlan no 125) Figs 1*a*, 2*a*, 3*a*, spikelets, × 1. Figs 1*b*, 2*b*, 3*b*, lower glumes, 1*c*, 2*c*, 3*c*, upper glumes, 1*d*, 2*d*, 3*d*, lemmas and paleae, all × 2 Figs 1*e*, 2*e*, 3*e*, apices of lemmas, × 4 Figs 1*f*, 2*f*, 3*f*, portions of surface of lemmas, with midrib at right and margin at left, showing pubescence, × 8

ence, Pinal County, *Harlan* 107 (UC); Red Rock, Pinal County, *Harlan* 105 (UC).

As stated previously, the chromosome number 2n=84 has been determined in all of the Harlan collections cited

Without having seen the type specimen, the writer cannot determine whether *B arizonicus* is the same as *B carinatus californicus* Shear, or *B californicus* Nutt Nuttall's specific name is a *nomen nudum* (cf Shear 1900), and his specimen, according to Shear, "is a mere scrap," of which the locality of collection is indefinite. Nevertheless, the specimens cited by Shear under *B. carinatus californicus*, since all come from San Diego or Lower California, are very likely *B. arizonicus*.

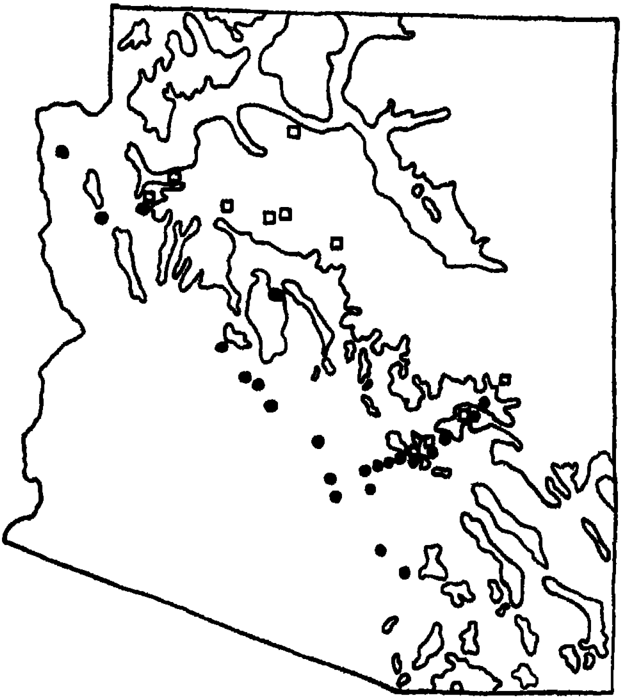


Fig 4 Map showing distribution of Harlan collections of *Bromus arizonicus* ($2n = 84$), solid circles, and *B polyanthus* vel aff ($2n = 56$), hollow squares, in Arizona The 5000 foot contour level is drawn

The characteristics which distinguish *B arizonicus* from all other members of the subgenus Ceratochloa in the Western United States are the *strictly* annual habit (the plants always die when the seeds have matured), the elongate glumes, the hirsute pubescence near the margin of the lemmas, and the rather prominent lobes of at least the upper lemmas (fig. 2) All of the typical, octoploid members of the *B carinatus* complex as grown in Berkeley produced some new tillers after the seed had ripened, except when the plants were obviously diseased. In all of them the lowest lemma is distinctly longer than the upper glume, its pubescence, whether long or short is more or less evenly distributed over the surface, and the lobes are very short, with the lateral nerves ending far below their base (fig 1)

The relative distributions of *B arizonicus* and the octoploids referred to *B polyanthus* are shown on a map (fig 4) giving the localities from which chromosome counts were obtained Only one collection from California has been counted, that from Tehachapi (no 128), but the external morphology of the other California specimens cited leaves no doubt as to their specific identity At Davis, California, the northern limit of its known range, *B arizonicus* is obviously a recent introduction along the railroad tracks, and it is very likely introduced at the San Joaquin Valley localities also

TABLE 1

Comparisons of the Diagnostic Characteristics of *B carinatus*, *B arizonicus*, and Their F_1 Hybrid

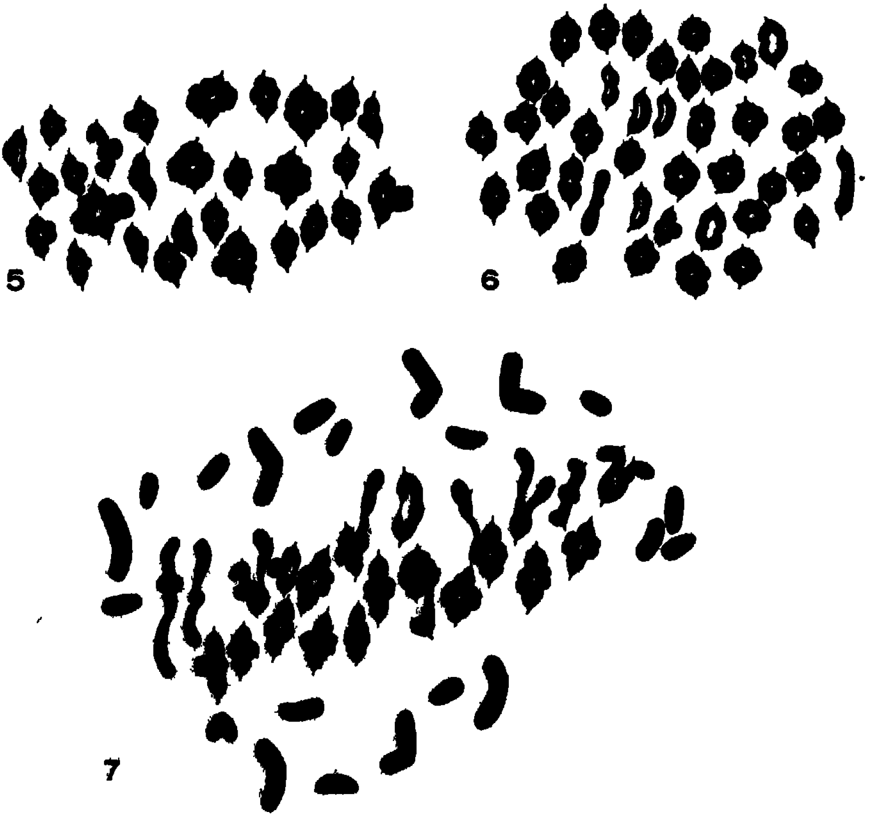
	B carinatus (no 5)	F_1 hybrid (no 125 × no 5)	*B arizonicus* (no 125)
Number of nodes of culms	5–6	5	4 5
Pubescence of top node	+ below	++ throughout	+ throughout
Pubescence of upper culm leaf	+ lower	++ upper + lower	+ upper 0 lower
Maximum number of branches at node of panicle	5–8	4–5	4–6
Maximum number of florets per spikelet	8–9	7–9	6–7
Length second glume	14 3	16 0	12 4
Length second lemma	16 4	15 2	12 3
Ratio, glume/lemma	0 87	1 05	1 01
Pubescence of second lemma	++ throughout	++ margins + back	++ margins 0–+ back
Lobes of upper lemmas .	small	intermediate	prominent

The particular strain of *B arizonicus* used for hybridization was one of the most vigorous and latest in flowering of all As recorded elsewhere (Harlan, 1942, Stebbins and Tobgy, 1944), the no 5 strain of *B carinatus* is also a very vigorous one It is about intermediate or somewhat late in flowering compared to other Berkeley strains, but earlier than most of the montane types. It is distinguished from most other *B. carinatus* strains from Berkeley by its rather large spikelets and lemmas, the average length of the lemmas and awns in *B carinatus* as a whole is not very different from that in *B arizonicus*. The chief distinguishing characteristics of the two parental strains are given in Table 1

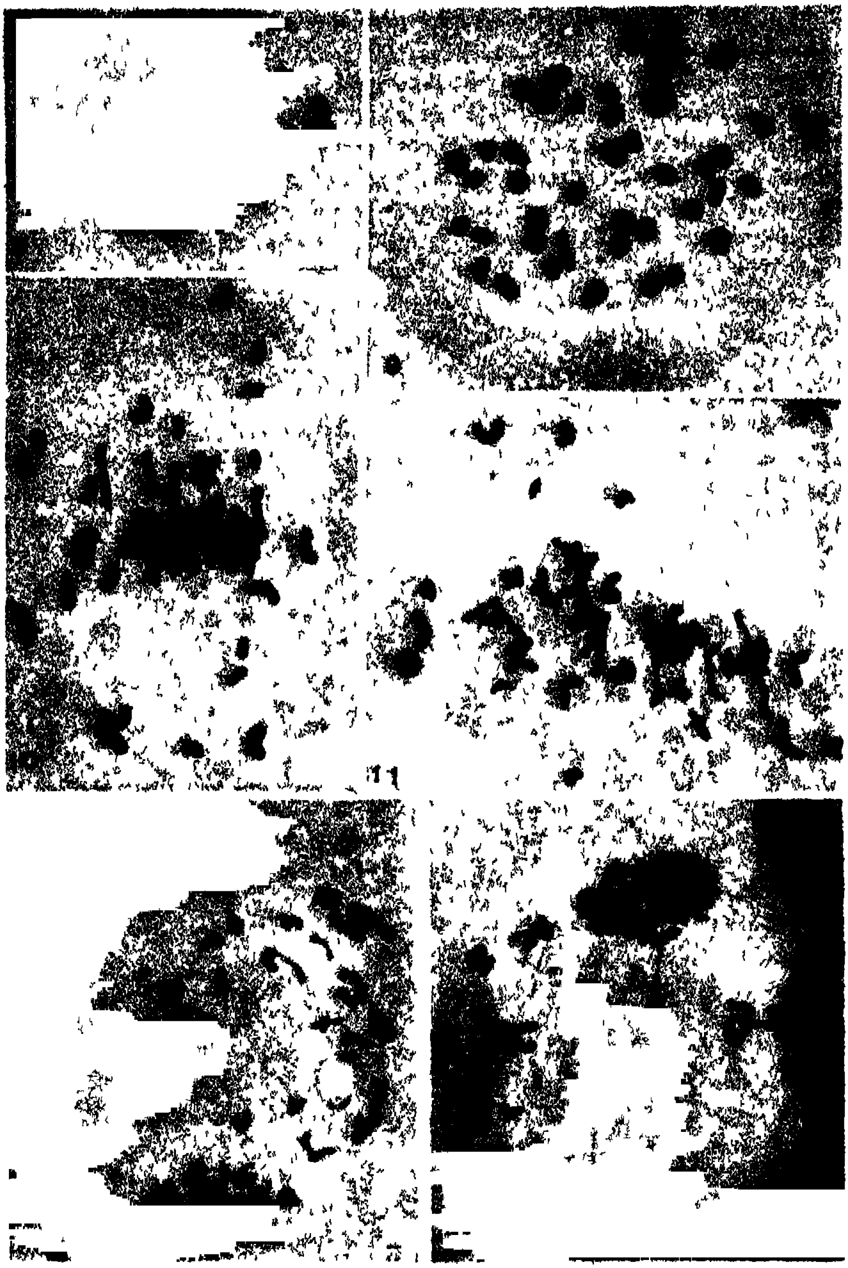
No hybrid seeds were obtained out of 42 florets emasculated when *B. arizonicus* was used as the pollen parent on *B. carinatus* In the reciprocal cross, *B. arizonicus* ♀ × *B carinatus* ♂, 37 seeds were obtained out of 40 florets emasculated. Of these, 10 were sown in September, 1942. Four were lost through an accident, and six were planted in the field in November. Of these 4 turned out to be hybrids Morphologically, they were intermediate between their parents, except that in number of florets per spikelet they were nearer their *B carinatus* parent, and in relative size of glumes and lemmas, like *B arizonicus* (Table 1) They proved to be completely pollen and seed sterile, a condition which would be expected from the cytological situation described below Three of them died during May, 1943, even before their annual *B arizonicus* parent A fourth showed some tendency to grow out after being cut back, as does *B carinatus*, but died during the fall of 1943

CYTOLOGY OF THE PARENTS AND HYBRID

1. *B. carinatus*. The meiotic chromosome behavior of strain no 5 of *B carinatus* used in this study has been reported earlier (Stebbins and Tobgy, 1944) The main features may be outlined here At diakinesis and I-meta-



Figs 5–7, chromosome pairing at first metaphase in 5, *B. carinatus*, 6, *B arizonicus*, 7, *B arizonicus* × *carinatus* All reproduced × 1300



Figs 8–13 Photomicrographs showing chromosome behavior, all reproduced × 800. 8, *B. carinatus*, I metaphase, 9, *B arizonicus*, diakinesis; 10 and 11, *B. arizonicus* × *carinatus*, I metaphase 12 and 13, *B arizonicus* × *carinatus*, I anaphase.

phase there were always 28 bivalents, no univalents or multivalents were ever seen. Seven bivalents could be distinguished by their conspicuously large size, while the remaining 21 bivalents were uniformly smaller and may therefore be termed medium-sized (figs 5 and 8) At I-metaphase most of the bivalents had two chiasmata, one in each arm, and occasionally some of the large bivalents had three chiasmata. The majority of the bivalents, large and medium-sized, were therefore pairing in both arms, although rarely one or two of them were pairing in one arm only In 9 per cent of the I-anaphase cells and in 1 per cent of the II-anaphase cells one inversion bridge and a fragment were seen. Almost 99 per cent of the tetrads had 4 normal microspores; in the remaining 1 per cent, one or two micronuclei were also present There was 81 0 per cent stained pollen

TABLE 2

CHROMOSOME PAIRING AT MEIOSIS IN *Bromus arizonicus* × *carinatus*

Combination				No of cells*	Per cent
m_{III}	m_{II}	m_I	l_I		
7	14	14	7	12 (2)	33 5
6	15	15	7	6	16 2
5	16	16	7	6	16 2
4	17	17	7	9 (2)	24 3
3	18	18	7	2 (1)	5 4
2	19	19	7	2 (1)	5 4
Total				37	100 0

* The numbers in parentheses refer to 6 cells in which two of the chromosomes regularly forming a m_{II} appeared instead as $2m_I$

2 *B arizonicus*. At diakinesis and I-metaphase of *B arizonicus* there were always 42 medium-sized bivalents (figs 6 and 9); univalents and multivalents were significantly missing There was no differentiation into large and small bivalents and none of the bivalents could be classified in the large size category characteristic of seven bivalents in *B. carinatus*. In almost half of the I-metaphase cells all the bivalents were paired in both arms and in the other half one, two, or three bivalents were paired in one arm only There was less inversion hybridity exhibited in the *B arizonicus* plant examined than in that of *B. carinatus*. Only 1 per cent of the I-anaphase cells and 0 4 per cent of the II-anaphase cells showed one chromatid bridge and one fragment About 2.5 per cent of the tetrads had one or two micronuclei in addition to the 4 normal microspores, but the remaining 97.5 per cent had 4 large microspores only. There was 90 per cent stained pollen

3. *B. arizonicus* × *B. carinatus*. The F_1 hybrid plants (2n=70) between *B. arizonicus* (2n=84) and *B carinatus* (2n=56) received 42 medium-sized

chromosomes from *B. arizonicus* and 21 medium + 7 large chromosomes from *B. carinatus*. Thirty-seven cells at I-metaphase were completely analyzed in the hybrid (Table 2).

Pairing of the parental chromosomes followed a comparatively simple scheme which may be described as follows:

1 The 7 large chromosomes from *B carinatus* were always seen as 7 unpaired univalents (1_I in the table)

2 At least 2 sets of 7 medium chromosomes from *B arizonicus* also appeared as 14 unpaired univalents (m_I in the table)

3 At least 14 medium bivalents were almost always seen (m_{II} in the table), these being formed from the consistent pairing of 2 sets of 7 medium chromosomes from *B arizonicus* with 2 corresponding sets from *B. carinatus*

4 A maximum number of 7 trivalents was formed (m_{III} in the table), these resulted from partial or complete homology between one set from *B arizonicus*, another from the same species, and a third from *B carinatus* When the maximum number of 7 trivalents was formed, there were 14 medium bivalents, 14 medium univalents and 7 large univalents in the cell. With decreasing numbers of trivalents, the number of bivalents and univalents was correspondingly increased A typical I metaphase cell is shown in figure 7, and two other cells in figures 10 and 11 The percentage of cells with these verying numbers of trivalents is given in the last column of Table 2 A slight reduction in the normal pairing in a few cells was found (cf footnote, Table 2)

TABLE 3

SPORAD ANALYSIS IN *B arizonicus* × *carinatus*

Number of cells in sporad	Number of micronuclei			Totals	Per cent
	7–11	12–16	17–21		
4 cells	29	51	27	107	58.5
5 cells	15	23	6	44	24.0
6 cells	8	13	4	25	13.7
7 cells	2	4	1	7	3.8
Totals	54	91	38	183	
Percentages	29.5	49.7	20.8		100.0

There was good evidence of extensive inversion hybridity in the F_1 This was shown by bridge-fragment configurations in 48.5 per cent of the cells at I-anaphase and by 16.5 per cent of the cells at II-anaphase. Usually only one bridge and occasionally two were seen at I-anaphase, and only once was a cell with three bridges encountered (fig. 13) All the bridges at II-anaphase were genuine second division bridges and not relics from the first division Therefore the extent of inversion hybridity in the hybrid may be represented as one bridge in 65 per cent of the pollen mother cells. It could not be always determined whether the inversions were confined to the bivalents or were found in the trivalents also, but evidence was obtained of bridges in both types of configurations Therefore it is likely that the two groups of parental chromosomes which regularly pair differ by inversions as well as the two partly homologous sets from *B. arizonicus* which enter into the trivalents. Since heterozygosity for inversions was found to a small degree in both parents, it is reasonable to suppose that most of the pairing sets differ by at least a few inversions

The majority of the univalent chromosomes divided equationally and the two daughter univalents separated to the two poles at I-anaphase, but occasionally some of the univalents, though already divided, would fail to undergo the anaphasic separation and would pass entirely to one pole or the other (figs 12 and 13) There was excessive chromosome lagging at the second division, which, together with that at the first division, may best be represented by the very complex condition of the sporads (Table 3)

With such conditions prevailing in the sporads the repeated observation of complete sterility of both pollen and ovules is the expected condition

DISCUSSION

Specific distinctness of B arizonicus The experimental evidence presented here shows that, because of the extreme abnormality of meiosis in their F_1 hybrid, and the complete inviability of both pollen and ovules, *B arizonicus* and *B carinatus* are completely incapable of interbreeding, that is of exchanging genes Therefore, they would be recognized as distinct species under any modern definition of this entity (cf Dobzhansky 1941, p 373) Furthermore, the cytological evidence indicates that *B arizonicus* would be equally intersterile with any other octoploid member of the *B. carinatus* complex (cf Stebbins and Tobgy, 1944) The two species clearly are not made up of the same chromosomal material Out of the haploid complement of 42 in *B. arizonicus*, 21 chromosomes are nearly or quite homologous to 21 of the haploid set of 28 in *B carinatus*, 7 are partly homologous with 7 of these 21 *carinatus* chromosomes and 14 are entirely different The resemblance between *B arizonicus* and *B carinatus*, therefore, lies principally in their common possession of 21 pairs of medium-sized (m) chromosomes

Cytological constitution and possible origin of B. arizonicus In another paper (Stebbins and Tobgy, 1944) it was shown that the 21 medium-sized chromosomes (m) in *B carinatus* are almost completely homologous with the 21 chromosomes which form the entire haploid complement of the South American species, *B catharticus* Vahl (*B unioloides* HBK) In that paper, these sets were designated AABBCC, so that the genome formula of the various octoploid members of the *B. carinatus* complex was written as AABBCCLL, LL representing the sets of 7 large chromosomes. The present evidence shows that *B. arizonicus* possesses the AABBCC set, perhaps somewhat modified, but lacks the 7 pairs of large, or the LL chromosomes Of its other three sets, one may be designated as C_2 C_2, because of its similarity to one set of the *catharticus* group, this partially homologous set being arbitrarily designated as the CC one The remaining two sets of *B arizonicus* may be designated DDEE

Thus the genome formula of *B. arizonicus* may be written $AABBC_1C_1C_2C_2$ DDEE. It should be clearly understood that this formula is used only to express pairing relationships, the actual genic content of the genomes probably varies considerably from species to species, and they undoubtedly differ in the various species by minor structural variations

This cytological constitution indicates that *B. arizonicus* is an allopolyploid derived by chromosome doubling from a hybrid between *B catharticus* or a close relative of it and some other species with 21 pairs of medium-sized chromosomes The identity of this other parent is not yet established, but based on the morphological differences between *B arizonicus* and *B. carinatus*, its main features can be postulated. They are as follows

1 It should be an annual, preferably found in desert or at least semiarid situations.

2 Its panicle branches should be slender, but should be glabrous or finely short-pubescent, rather than coarsely scabrous as in *B catharticus*

3 Its glumes should be elongate, definitely exceeding the lower lemmas The outer glume should have chiefly 3 nerves.

4. Its lemmas should be rounded on the back or weakly keeled, should be long hirsute near the margins, conspicuously bidentate at the apex, and long-awned.

5 It should form a maximum of 7 bivalents in hybrids with *B. catharticus* or *B carinatus*

The morphological characteristics listed here are found in only one species of *Bromus* known to us, *B Trinii Desv*. This species also has the required 21 pairs of medium-sized chromosomes, as determined by Knowles (1944) as well as by the senior author. Its pairing relationships with *B catharticus* and *B carinatus* have not yet been tested. The hypothesis may, however, be advanced that *B. arizonicus* is an allopolyploid derived from *B catharticus* and *B Trinii* or close relatives of these species It is hoped that this can be tested in the near future by appropriate hybridization experiments The hypothesis involves some difficulties from the historical point of view, since both of the putative parents are generally believed to be native only to South America, and to be recent introductions into the area now occupied by *B arizonicus*. This problem, however, had best be considered after the evidence in favor of the proposed hypothesis has become more definite

There is one cytological discrepancy found in the pairing behavior of the chromosomes of *B arizonicus* in the pure species as compared with their behavior in its hybrid with *B carinatus* The trivalents found in the hybrid indicates definitely a partial homology between two of the sets in *B arizonicus*. That they could not possibly consist of two sets from *B carinatus* and one from *B arizonicus* is evident from the fact that in another hybrid, *B. carinatus* × *B mollis*, the chromosomes nearly all remain unpaired, showing that there is little or no homology between any of the four sets found in *B. carinatus* (Knowles 1944) The difficulty is that these two partially homologous sets of *B. arizonicus* should occasionally form quadrivalents in the pure species However, in several different strains, examined by each of the three authors, the presence of 42 bivalents was observed with strikingly consistent regularity, and the partial homology between two of the sets was not even suspected until the cytology of the hybrid was studied. Two explanations for this phenomenon are suggested The first is that advanced by Müntzing and Prakken (1940) for a similar behavior in *Phleum pratense*, which was also found in the same species by Myers (1941). They assume that in *Phleum* and other genera there is a "special genotypically controlled tendency to bivalent formation" (p 494) The other explanation is that of differential affinity, or preferential pairing, advanced by Darlington (1927, p 198) to explain the lack of multivalents in the allopolyploid *Primula kewensis*, and by Skirm (1942), to explain the difference in pairing found in two different tetraploids of *Tradescantia*, both obtained from the same diploid hybrid From the data now at hand, there is no way of concluding which is the best explanation for the situation in *Bromus arizonicus*

In conclusion, the following points have arisen from this study which are of particular interest to students of the taxonomy of the Gramineae In the first place, whatever the second parent of *B arizonicus* is, it most certainly belongs neither to the section *Ceratochloa* nor to the section *Bromopsis*, as postulated for the second parent of the octoploid *B carinatus* and its relatives (Stebbins and Tobgy, *loc cit*) The morphological characteristics listed above would immediately remove the species from the former section, while in the latter the chromosomes are large, like the LL set of *B carinatus* (Stebbins and Love, 1941) Both *B carinatus* and *B arizonicus*, therefore, are allopolyploids from intersectional hybrids, but the two sections thus connected by allopolyploidy are different in each case Therefore the cytogenetic evidence entirely supports the recognition of *Bromus* as a single genus, rather than the separation of *Ceratochloa* as generically distinct, as has been done by a number of agrostologists It speaks even more emphatically against the splitting of *Bromus* into several different genera, as was proposed by Nevski (1934)

In the second place, the particular type of relationship which exists between *B carinatus* and *B arizonicus* will probably be found to be rather frequent when more genera of this family are studied cytogenetically, since polyploidy is so prevalent in them They are a typical example of species which are morphologically very similar, and cytogenetically partly very similar and partly very different Their similarities are due to their common possession of the *B catharticus* set Their morphological differences represent, in a much diluted form, the differences between two different sections of the genus Both of these sections diverge from typical *Ceratochloa* in their much less strongly keeled lemmas and much longer awns, hence both *B arizonicus* and *B carinatus* diverge from *B catharticus* in the same respects *B. carinatus* and *B arizonicus* may therefore be spoken of as *allosyngenic amphidiploids* (or allopolyploids), since they differ in respect to one of their original parents, and have the other in common The likelihood is that in all genera possessing large polyploid complexes, allosyngenic amphidiploids form one of the chief sources of taxonomic difficulty.

SUMMARY

1. A new species, *B. arizonicus*, is described, based on *B. carinatus* variety *arizonicus* Shear This species has the somatic chromosome number $2n = 84$, as compared with $2n = 56$ for *B carinatus.*

2 The hybrid, *B. arizonicus* × *B carinatus*, can be obtained only when *B arizonicus* is the female parent It is morphologically intermediate between its parents and is completely sterile

3 At meiosis this hybrid regularly shows a maximum of 7 trivalents, with the rest of the chromosomes existing as bivalents and univalents The 7 large chromosomes obtained from *B carinatus* have no homologues in *B arizonicus,* and therefore are always unpaired, as are also 14 medium-sized chromosomes from *B arizonicus*

4 The presence of bridge-fragment configurations in either the first or the second division of meiosis in 65 per cent of the pollen mother cells indicates that the chromosomes of two or more of the pairing sets differ by a number of inverted segments

5 The cytogenetic evidence amply demonstrates the specific distinctness of *B carinatus* and *B arizonicus* Their genomic formulae may be written as follows for *B carinatus* $AABBC_1C_1L_1L_1$, for *B arizonicus* $AABBC_1C_1C_2C_2DDEE$ The A, B, and C_1 sets constitute the chromosomal complements of *B catharticus* It is possible that *B arizonicus* possesses this complement in a slightly modified form

6 The hypothesis is advanced that *B arizonicus* is an allopolyploid derived from doubling of the chromosome number in a hybrid between *B catharticus* or a close relative of that species and some other species with 21 pairs of medium-sized chromosomes, not belonging to the subgenus Ceratochloa

7 The cytogenetic evidence here presented supports the retention of *Bromus,* sens lat, as a single genus

8 The relationship of *B carinatus* and *B arizonicus* is described as that of allosyngenic amphidiploids This type of relationship is believed to be a common source of taxonomic difficulty in genera which have highly developed polyploid complexes

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No. 14

THE IMPORTANCE OF FIELD HYBRIDS IN DETERMINING SPECIES IN THE GENUS CEANOTHUS

BY

HOWARD E McMINN
Professor of Botany, Mills College

EVERY FIELD BOTANIST, having the faculty of careful observation, is repeatedly impressed with the number of apparent hybrids which occur in certain genera of seed-bearing plants The genus *Ceanothus* is one of these genera According to Katherine Brandegee, Dr C C Parry was the first to call attention to the prevalence of natural hybrids in this genus Mrs Brandegee in her "Studies of Ceanothus" (1894) discussed the various hybrids which she had observed in the field and herbaria She was of the opinion that most of the hybrids between members of the same section were fertile but she gave no supporting evidence She stated that, "The only infertile hybrid, within its section, known to me is No 69, *C incanus* × *papillosus* In this the ovaries are more or less abortive and no fruit was formed." If we accept the sterility test for distinct biological species, the two parents, *C incanus* and *C papillosus,* in this cross belong to two different species complexes (cenospecies of the experimentalist) John Thomas Howell (1940a) presents the case of hybridization between certain species of the section *Cerastes* His conclusion is worthy of note: "My general conclusion is that anyone interested in the taxonomy and the possible evolution of entities in the subgenus *Cerastes of Ceanothus,* cannot disregard the probable effect of hybridization, and that some of our puzzling entities can be more definitely limited as taxonomic units with the proper study and interpretation of intermediates of suspected hybrid origin." Many botanists have been reluctant to accept the importance of hybridization in the evolution of the numerous forms of *Ceanothus* and some ignore it entirely. However, anyone who has done much serious field study of this genus will come to agree with Howell's general conclusion

It is the opinion of the writer that the number of true biological species (ecospecies of the experimentalist) existing at a given time in any genus of plants cannot be known until extensive experimental studies for testing the fertility of hybrids can be carried out Until more logical methods for the determination of true biological or distinct species are set forth, botanists will do well to test out the numerous variants within a genus by putting them through the biological sterility sieve advocated by Clausen, Keck, and Hiesey (1939) shown in table 1.

TABLE 1 *The concept of species*

Degree of separation Internal External	Hybrids fertile, second generation vigorous	Hybrids partially sterile, second generation weak	Hybrids sterile or none
In different environments	Distinct *subspecies* ECOTYPES	Distinct *species* ECOSPECIES	Distinct *species complexes*, CENOSPECIES
In the same environment	*Local variations* of one species BIOTYPES	Species overlapping in common territory (with hybrid swarms)	

Experimental methods require much time and labor, and it is evident to botanists who study woody plants that the adoption of the experimental method will be slow, and until such adoption other methods now employed by workers will continue to be used However, by being aware of the importance of experimental methods, field workers will become more alert to the existence of natural hybrids and to geographic and ecological variations By recognizing field hybrids and applying to them the same principles used by Clausen, Keck, and Hiesey in determining experimentally cenospecies, ecospecies, ecotypes, and biotypes, it has been possible to gain much helpful information in determining species complexes (cenospecies), distinct or biological species (ecospecies), subspecies (ecotypes), and local variations (biotypes) in the genus *Ceanothus*

In this genus there are two rather well-defined sections or sub-genera, *Euceanothus* with leaves alternate and fruit not horned, and *Cerastes* with typically opposite leaves and horned fruit (Plate 28) In a recent publication, by Van Rensselaer and the writer (1942) the *Euceanothus* section includes thirty-three binomials (so-called species), seventeen trinomials (varieties), many minor variations, four named natural hybrids, and many other hybrids.

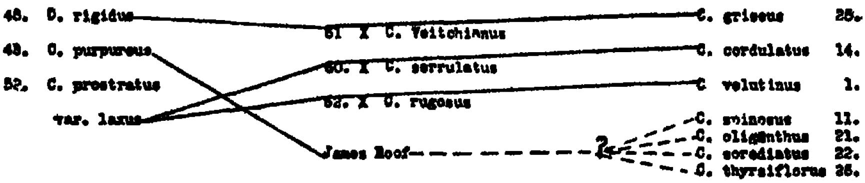
The *Cerastes* section includes twenty-three binomials, nine trinomials, many minor variations, four named natural hybrids, and other hybrids Three named natural hybrids between members of the two sections are also included The writer believes that the number of existing distinct species (ecospecies) is much fewer than represented by the number of binomials given in manuals, and that more subspecies (ecotypes) and local variations (biotypes) will be recognized when sufficient knowledge of the behavior of the hybrids is known Some of this behavior can be learned by careful observation in the field

INTERSECTIONAL HYBRIDS

If observed hybrid plants fail to set fruit year after year, one may assume with some degree of certainty that they are sterile, and that their parents belong to distinct species complexes (cenospecies) This situation is partially exemplified in the intersectional cross between *C prostratus* and *C cordulatus* which has been given the designation × *C serrulatus* This hybrid was first collected in 1926 from a small colony of not more than four or five plants in a shallow draw on a ridge between Emerald Bay and Cascade Lake, Eldorado County, California To my knowledge it has never been found at any other locality. It appears that a single hybrid plant may have been formed and that the other plants have resulted from natural layering The evidence for considering the two parents of this hybrid as belonging to different species complexes would be more conclusive if more sterile hybrid plants were known Associated with this hybrid is *C prostratus, C cordulatus*, and *C velutinus* The prostrate habit and the presence of sunken stomatal pits on the underside of the leaves relate it to *C prostratus*, but the predominantly thinner and alternate leaves, the small deciduous stipules, and short racemose flower clusters relate it to *C cordulatus* The presence of both opposite and alternate leaves and the very pale blue to nearly white flowers seem to be intermediate characters The plants have never been known to set fruit

CHART 1

Natural Hybrids between Species of the Sections Cerastes and Eucoenothus



Two other field hybrids and six garden hybrids have been observed by the writer between members of the two sections (Chart 1) Only one of these hybrids, the garden hybrid *C James Roof*, has ever been known to set fruit The seeds of this hybrid when tested failed to germinate The parents were *C purpureus* and probably one of the following· *C oliganthus, C spinosus,* *C. thyrsiflorus*, or *C. sorediatus*. The two other observed field hybrids between members of the two sections are × *C. rugosus* and × *C. Veitchianus*. × *Ceanothus rugosus* appears to be a hybrid between *C. prostratus* and *C. velutinus*. Specimens have been obtained from two localities, one from the lava beds near Egg Lake, Modoc County, California, and the other from near Truckee, Nevada County, California. M. S. Baker and F. P. Nutting collected the specimens from Modoc County in 1894. Baker in a note states that the plant was a "decumbent form of *C. velutinus*—probably a hybrid of *C. prostratus* and *C. velutinus*." The specimens from Truckee were collected by C. F. Sonne in 1890. Sonne reported that the plant sets flowers sparingly and that it does not fruit at all. It would seem then, that the two parents, *C. prostratus* and *C. velutinus*, definitely belong to different species complexes.

× *Ceanothus Veitchianus* appears to be a hybrid between *C. griseus* and probably *C. rigidus*. To my knowledge it was first collected by William Lobb in California, probably near Monterey where *C. griseus* and *C. rigidus* grow. Lobb probably collected seeds from *C. griseus* and *C. rigidus* and from this collection appeared the hybrid × *C. Veitchianus* in the Veitch and Sons nurseries of Exeter and Chelsea, England. I have seen no specimens collected from the field. The few garden hybrids of × *C. Veitchianus* which I have observed have never set fruit. It would appear from the sterility test that *C. rigidus* and *C. griseus* belong to different species complexes.

The genetic barrier between the two sections must be something more than chromosome number, because the diploid number for all species examined in the two sections by Nobs (1941) is 24 (Plates 29 and 30). Nobs also examined six hybrid plants of different parentage and all were found to have the same number of chromosomes as the parents, namely $2n = 24$.

INTRASECTIONAL HYBRIDS

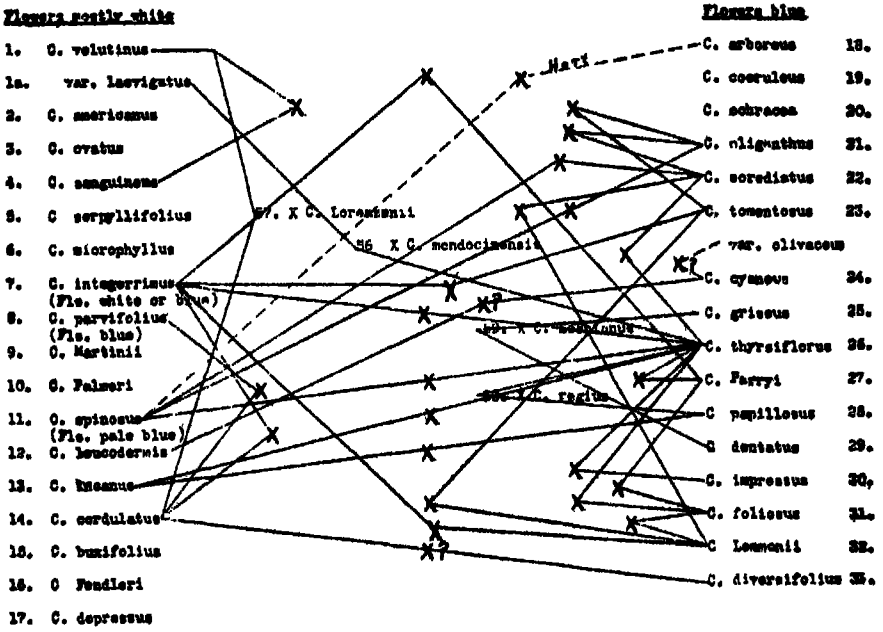
If observed hybrid plants are partially sterile and set fruit which produce seeds that germinate poorly or whose seeds produce a weak second generation, we may assume that the hybrid plants were produced by the crossing of distinct species (ecospecies of the experimentalist). If the hybrids proved to be fertile and the second generation vigorous, we may then assume that their parents belonged to distinct subspecies (ecotypes of the experimentalist) or that they were local variations of one species (biotypes of the experimentalist), depending upon whether they occurred in different environments or in the same environment. Examples of such hybrids have been observed many times in the field between members of the same section of the genus wherever they overlap in their distribution.

SECTION *Euceanothus*

In the section *Euceanothus*, the evidence from hybridization points toward the existence of more cenospecies and ecospecies than in the section *Cerastes*. In this section (*Euceanothus*) hybrids have been observed between most of the species that occupy the same area and that flower at the same time In some cases where two species, as *C. cordulatus* and *C. diversifolius* or as *C thyrsiflorus* and *C incanus*, occur together only an occasional hybrid plant is formed and that plant usually appears to be totally sterile. In these cases we may assume that *C cordulatus* and *C diversifolius* belong to different species complexes (cenospecies) and also that *C thyrsiflorus* and *C incanus* belong to different species complexes Since neither *C cordulatus* nor

CHART 2

Natural Hybrids between Species of the Section Euceanothus



C diversifolius are ever found in nature growing with either *C thyrsiflorus* or *C incanus*, no evidence from field hybrids has been obtained regarding their interrelationships From morphological characters it would seem that *C cordulatus* and *C incanus* belong to the same species complexes, and that that complex is different from the one to which *C thyrsiflorus* or the one to which *C diversifolius* belongs

In the natural hybrids observed between *C cordulatus* and *C velutinus* and between *C thyrsiflorus* and *C papillosus* on the other hand, many variations occur which appear to be only partially sterile and which appear to be members of a hybrid swarm, thus indicating that probably these two entities are distinct species (ecospecies) If these hybrids were quite fertile and their second-generation vigorous, more local variations would be expected than are now found, and then these four entities would be considered subspecies (ecotypes) or local variations of one species (biotypes), depending upon whether they normally occurred in different environments or in the same environment Most of the other crosses observed in the *Euceanothus* section, and recorded in chart 2, appear to follow the same general patterns as given in the examples just cited

A summary of the recorded natural hybrids in this section shows a total of thirty, involving twenty-one species *Ceanothus thyrsiflorus,* which in its distribution contacts more species than any other entity in the *Euceanothus* section, has entered into nine crosses, whereas the other species with fewer contacts have been involved in from one to five crosses Three of the thirty crosses have been given hybrid binomial designations because they have been considered as species or varieties by other workers One other hybrid has been named because of its presence in the nursery trade Since much confusion exists in the literature about these hybrid entities, it seems worth while to give a brief account concerning them

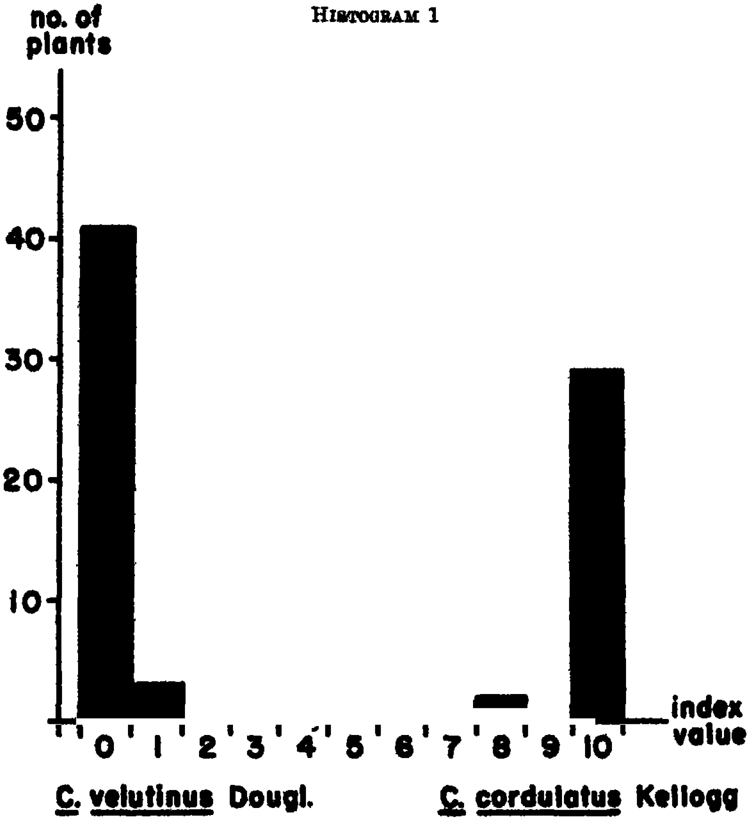
NAMED HYBRIDS OF THE SECTION *Euceanothus*

Ceanothus mendocinensis appears to be a hybrid between *C thyrsiflorus* and *C velutinus* var *laevigatus* Plants of this cross have been collected in several scattered locations in Mendocino County, California, and in adjacent counties where the two parents overlap in their distribution They usually occur as individual plants with one or both parents, never in colonies The fertility of the seed has not been tested, but since so few plants have been found where the parents occur together, and since the hybrids appear to be rather uniform in those characters which are intermediate between those of the parents, it would appear that the plants were first-generation hybrids and that the parents belong to distinct species

× *Ceanothus Lorenzenii* has been considered to be a variety of *C velutinus* by some botanists It occurs in the Sierra Nevada of California from Kern County northward to Siskiyou County and eastward in Nevada Apparently this hybrid is the result of a cross between *C velutinus* and *C cordulatus* (Plate 31) Field studies made about five miles north of Markleeville, Alpine County, California, in the summers of 1941 and 1942, furnished the most convincing evidence On an extensive old burned-over area there occurred *C velutinus, C. cordulatus,* and *C prostratus* The hybrid plants were found only in areas where *C velutinus* and *C cordulatus* were closely associated In areas where one species occurred to the exclusion of the other no hybrids were observed Most of the hybrids resembled the species *C velutinus* more than *C cordulatus*. The stiff branches and smaller leaves without varnish above, however, gave evidence of the part *C cordulatus* had in its origin. A few plants were found which resembled *C cordulatus* more than *C velutinus* It appeared from the field studies that the hybrid plants were mostly sterile If they were quite fertile one would expect more individuals intermediate between the two parents and the hybrid (Histogram 1) I believe most of the specimens of × *C. Lorenzenii* are first generation hybrids. Nobs, after field and cytological studies, also concluded that *C. velutinus* var. *Lorenzenii* Jepson is a hybrid between *C. velutinus* and *C. cordulatus* (Plates 32 and 33).

× *Ceanothus Lobbianus* is probably the result of a cross between *C. griseus* and *C. dentatus*. It was first grown in England from seed collected by William

HISTOGRAM 1



X C. Lorenzenii (Jepson) McMinn

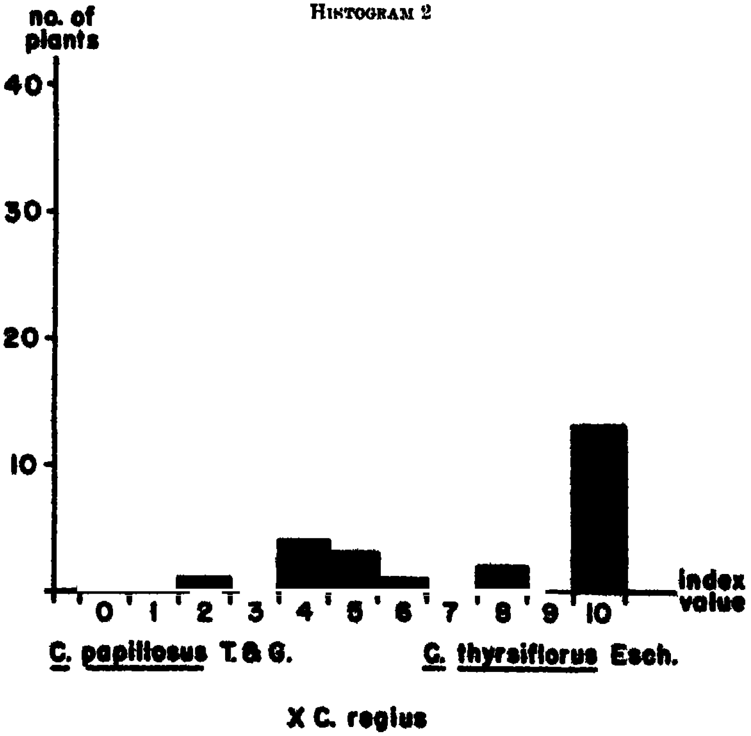
Histogram 1 represents the distribution of plants into 11 groups based upon an index value determined by studying 10 characters of *C. cordulatus*. The plants were taken from a random sampling in an area where *C. cordulatus* and *C. velutinus* overlapped in their distribution. Plants with all 10 characters were classified as *C. cordulatus*, plants with none of these characters were classified as *C. velutinus*, those with 4, 5, and 6 characters were classified as × *C. Lorenzenii*, and those with 1, 3, 7, or 8 characters are unnamed hybrids. No plant in the sampling was found with 2 or 9 characters. As the groups approach 0 the plants more closely resemble *C. velutinus*.

(× = hybrid)

Lobb in California, probably in the region of Monterey where *C. griseus* and *C. dentatus* occur. A few plants collected as natural hybrids in the Monterey region and now growing in California gardens approximate the type specimen of the original *C Lobbianus*. Seeds have been collected from these hybrids but their fertility is not known Since so few plants of this hybrid occur either in the wild or in any known garden collection it would seem that the hybrid is only partially fertile and therefore the parents, *C griseus* and *C dentatus*, belong to distinct species

×*Ceanothus regius* is a hybrid between *C thyrsiflorus* and *C papillosus* It has been observed several times wherever the two parents overlap in their distribution in San Mateo and Santa Cruz counties, California The hybrids give evidence of being only partially sterile, consequently the parents belong to distinct species (Plate 34, and Histogram 2).

Histogram 2



Histogram 2 represents the distribution of plants into 11 groups based upon an index value determined by studying 10 characters of *C thyrsiflorus* The plants were counted from a random sampling in an area where *C thyrsiflorus* and *C papillosus* overlapped in their distribution Plants with 10 characters were classified as *C thyrsiflorus*, those with none of these characters were classified as *C papillosus*, those with 4 or 5 characters were classified as × *C regius*, and those with 2, 6, or 8 characters were classified as unnamed hybrids. No plant in this sampling was found with 1, 3, 7, or 9 characters.

SECTION *Cerastes*

In the section *Cerastes* (those plants with typically opposite leaves) there appears to be more evidence for a greater number of subspecies and fewer species and species complexes. In this section, *C. cuneatus*, *C. Greggii*, and *C. prostratus* have wider ranges of distribution than any of the other entities and they have entered into more crosses than any of the others. Wherever *C. cuneatus* and *C. Greggii* and its vars. *vestitus* and *perplexans* overlap in their distribution, many intermediates occur which appear to be fertile. But since their degree of fertility is not known it is not possible to state whether the parents are in the nature of subspecies or species. In the crosses observed between *C. cuneatus* and *C. prostratus* the hybrid plants appear to be partially sterile, wherefore, their parents appear to be distinct species. At the present time no localities are known to the writer where *C. prostratus* and *C. Greggii* occur together. However, there is evidence in the southern middle Sierra Nevada of California that they may have overlapped in their distribution sometime in the past. In this area, particularly in Tuolumne and Calaveras counties, entities occur which seem to possess characters originating from both species. Two of these entities appear in some manuals as species binomials and are worthy of further consideration.

The apparently fertile entity known as *C. fresnensis* (Fresno Mat), occurs on the western slope of the Sierra Nevada between 3000 and 6500 feet elevation, from Fresno County northward to Tuolumne County or probably to Eldorado and Placer counties, mostly at the southern extension of the range of *C. prostratus*. In 1939 the writer gave the distribution of this rather baffling entity as extending from Fresno County northward to Plumas County. However, after becoming more aware of the presence of hybrids in this genus, extensive field studies were carried on during the summers of 1940, 1941, and 1942, and I am now of the opinion that some of the herbarium specimens studied from the more northerly localities had been taken from hybrid plants of *C. cuneatus* × *C. prostratus* and its variety *laxus*, and from *C. arcuatus*. *Ceanothus fresnensis* is entirely prostrate, while *C. arcuatus* and most hybrids between *C. cuneatus* and *C. prostratus* are usually intermediate between the two in habit of growth. That *C. Greggii* var. *vestitus* has entered into the origin of *C. fresnensis* is evidenced by the character of the pubescence and the nature of the fruit. *Ceanothus Greggii* var. *vestitus* now occurs in Kern, Inyo, and Mono counties and in the past may have overlapped in its distribution with *C. prostratus*. John Thomas Howell (1940) also considers the probability that *C. fresnensis* "is descended from the offspring of a fertile cross between *C. prostratus* and *C. vestitus*" (*C. Greggii* var. *vestitus*). If we accept an early hybrid origin of *C. fresnensis*, then *C. prostratus* and *C. Greggii* var. *vestitus* must have belonged to distinct subspecies.

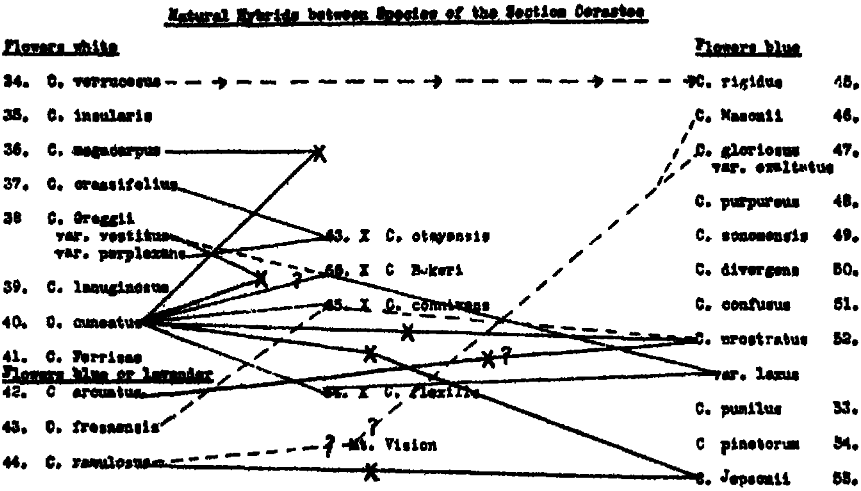
The other apparent fertile entity previously referred to is *C. arcuatus*. It occurs in scattered localities from about 3000 to 7600 feet elevation on the western slope of the Sierra Nevada of California from Madera County northward to Plumas County. Near the summit on the south slope of Robb's Peak, Eldorado County, elevation 6500 to 6700 feet, it is one of the dominant shrubs associated with *Arctostaphylos patula* and *Ceanothus prostratus*. A few prostrate plants which appear to be *Ceanothus fresnensis* also occur in this association. These may be hybrids of *C. prostratus* and *C. arcuatus.*

Ceanothus arcuatus seems to have segregated out of a hybrid population formed by the crossing of *C. cuneatus* with *C. fresnensis.* The habit of growth, character of fruit, and color of flowers are intermediate between the two probable parents. The grayish bark resembles that of *C. cuneatus* while the leaves resemble more those of *C. fresnensis.* In the Sugar Pine Ridge region along Highway 108, Tuolumne County, occur plants of *C. cuneatus* and *C. fresnensis* as well as hybrids between these two entities. At higher elevations along Highway 108 the hybrid form alone occurs. In Eldorado, Nevada, Placer, and Plumas counties, plants scarcely distinguishable from these hybrids occur in the Upper Transition and Canadian Life Zones far above the distribution of *C. cuneatus.* Since these plants are scarcely distinguishable from the hybrids of Tuolumne County and since they occur in a different geographical area in the absence of both *C. fresnensis* and *C. cuneatus,* I believe there are sufficient reasons for regarding them as belonging to a distinct subspecies or probably to a distinct species. It seems to me we have here a subspecies or a species which has "just arrived" and is now migrating northward from its center of hybrid origin.

The group of entities including *C. pinetorum, C. postratus* and its vars. *laxus* and *occidentalis, C. pumilus, C. confusus, C. divergens,* and *C. purpureus* has so many forms which appear to grade into each other that the entities may well exist as subspecies of one large polymorphic species. These entities are not only very closely related to each other but also to another smaller group composed of *C. rigidus, C. Masonii, C. gloriosus* and its var. *exaltatus.* The two groups differ slightly from one another in the character of the leaf margins. The former normally has leaves with serrate or spinulose margins, and the latter has leaves with dentate to quite entire margins. In the foothills of the Hood Mountain Range in Sonoma County, California, members of these two groups overlap in their distribution and have produced numerous hybrids, many of which appear to be fertile. Since the barrier between most of these entities appears to be that of geographic or ecologic isolation rather than genetic, it would seem that the entities are probably in the nature of subspecies. They seem to hybridize freely wherever they meet, but appear quite distinct in their own geographic ranges.

Ceanothus sonomensis of the Hood Mountain Range, Sonoma County, California, may be the result of the crossing of one of these hybrids with *C. cuneatus,* which occurs in the same area. This unit now occupies a small area somewhat isolated from the other forms of *Ceanothus* growing in that general region. When *C. cuneatus* is brought into the picture it brings in another series of forms which seems to hybridize with the others, and until experimental methods are used it would be unwise to make predictions as to the exact nature of the entities. That *C. sonomensis, C. arcuatus,* and several other somewhat similar entities in the section *Cerastes* might be the results of interspecific hybridization cannot be entirely ruled out G. Ledyard Stebbins (1942a) has pointed out in his paper on the "Role of Isolation in the Differentiation of Plant Species" that occasionally recombinations should occur in the progeny of a partially sterile interspecific hybrid involving "small units genetically independent of morphological differences." He further states that "Some of these new recombinations could be fertile types which would be different in appearance from either of their original parents and exhibit partial intersterility with both of them They would thus become the progenitors of new species"

CHART 3


Natural Hybrids between Species of the Section Cerastes

A summary of the recognized natural hybrids in the section *Cerastes,* as given in the book *Ceanothus,* gives a total of twenty-one, of which four are named and seventeen unnamed (Chart 3) The four named hybrids represent binomials which have appeared as distinct species in some publications Eight so-called species of this section have entered into the hybrid complex *Ceanothus cuneatus, C. prostratus,* and *C Greggii* are the most widely distributed named entities and they have entered into crosses more often than any of the other named entities *Ceanothus verrucosus,* a species with relatively few variations, to my knowledge has not entered into any natural cross. This species has a rather limited range of distribution in San Diego County, California, which does not overlap with the distributional ranges of other species in the same section According to the concept of genetic homogeneity as reviewed by Stebbins (1942), we might consider that *C verrucosus,* because of its limited distribution, is genetically homogeneous and that it consists of relatively few biotypes which in turn are relatively homozygous. On the other hand we might consider *C. cuneatus, C prostratus,* and *C Greggii,* since they are widespread species, as being heterogeneous in their genetic make up. This heterogeneity is well exemplified by the numerous biotypes which occur in these species

NAMED HYBRIDS OF THE SECTION *Cerastes*

× *Ceanothus otayensis* in known only from Otay Mountain in San Diego County, California, and is here considered to have originated as the result of a cross between *C crassifolius* and *C. Greggii* var *perplexans.* Both of these entities occur together on Otay Mountain The hybrid plants bear good fruit and the seeds appear to be fertile If they are found to produce strong second generation plants, then the two parents, *C crassifolius* and *C Greggii* var *perplexans,* must be considered to belong to different subspecies One evidence for their fertility is the amount of variability which occurs among the hybrid plants

The name × *Ceanothus flexilis* has been given to those hybrid plants occurring in northern Shasta, Lassen, and southwestern Modoc counties of California In these localities *C cuneatus* and *C prostratus* var *laxus* overlap in their distribution and they are considered to be the parents of × *C flexilis* The habit of growth, many leaf characters, size of fruit, and flower color are usually intermediate between the two parents The fertility of the hybrids is not known, but from field observations I would suspect partial sterility If the suspicion is proved to be a fact by experimental methods, then the parents, *C cuneatus* and *C prostratus,* belong to distinct species

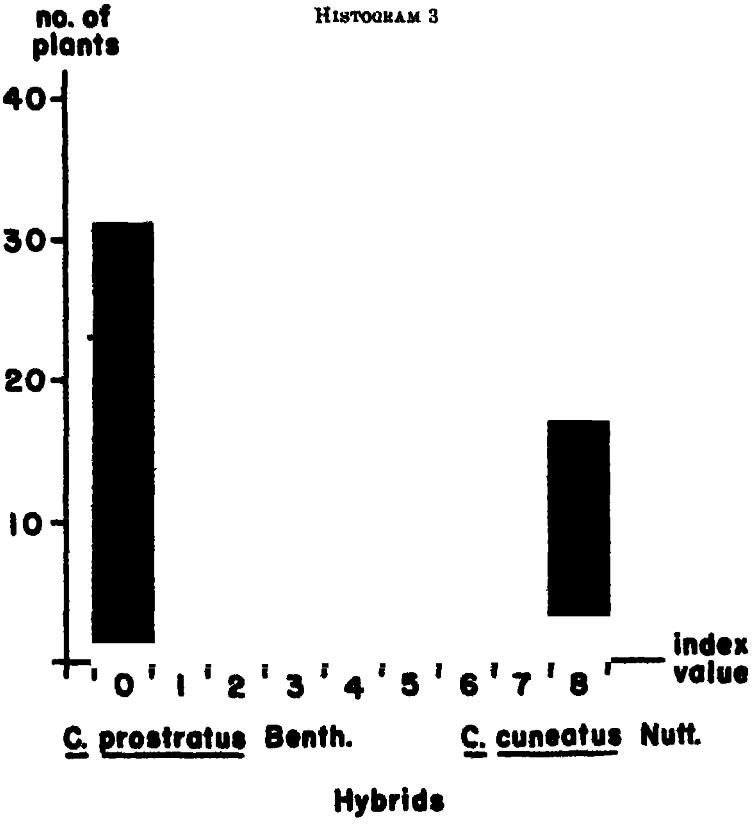
× *Ceanothus Bakeri* is another named hybrid which appears to have resulted from a cross between *C prostratus* var *laxus* and either *C Greggii* var *vestitus* or one of the many varieties of *C cuneatus* The single plant known to me of this hybrid was collected by C F Baker from Kings Canyon, Ormsby County, Nevada, in 1902 The three fragmentary specimens resemble somewhat specimens of × *C flexilis* and × *C connivens,* both of which probably have genes of *C. prostratus* in their makeup. This small bit of evidence would favor the assumption that *C. prostratus* and *C Greggii* or *C cuneatus* belong to distinct species

Specimens representing the named hybrid × *C connivens* were collected from near Sheep Ranch, Calaveras County, California, by E L Greene and by T S Brandegee Field studies in the Calaveras-Sheep Ranch area in 1941 failed to disclose any specimens which quite resembled the specimens of the earlier collectors However, in the Calaveras-Tuolumne area, where *C. cuneatus, C prostratus,* and *C fresnensis* grow, many hybrid plants occur, some of which appear much like × *C connivens* It is probable that × *C connivens* represents a cross between *C cuneatus* and either *C. prostratus* or *C fresnensis*

In concluding this paper mention should be made of the numerous other hybrid plants which occur between *C cuneatus* and *C prostratus* wherever these two species occupy the same local area (Plates 35 and 36 and Histogram 3) *Ceanothus cuneatus* is primarily a component of hard chaparral in the Upper

Sonoran Life Zone, while *C prostratus* occurs chiefly in the open pine forests of the Transition and Lower Canadian Life Zones However, along the none-too-well-defined borders of these life zones these two entities overlap in their distribution and also in their characteristics Some of the hybrids observed appear to have good fruits and seeds, whether the seed produce strong and

HISTOGRAM 3



Histogram 3 represents the distribution of plants into 9 groups based upon an index value determined by studying 8 characters of *C cuneatus* The plants were taken from a random sampling in an area where *C cuneatus* and *C prostratus* overlapped in their distribution Plants with 8 characters were classified as *C cuneatus*, plants with none of these characters were classified as *C prostratus*, and those with 1, 2, 3, 4, 5, 6, or 7 characters were classified as unnamed hybrids Plants with a decreasing number of *C cuneatus* characters possessed an increasing number of *C prostratus* ones

fertile offspring is not known Since the hybrid forms do not vary as much as F_2 and F_3 offspring usually do from heterozygous parents, and since there are relatively few individuals compared to the number of individuals of both parents, I believe the hybrids are partially sterile and that their parents are distinct species

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I wish to express my sincere appreciation to Mr M A Nobs and Mr John Poindexter for furnishing the data and photographs for plates 29 to 36 and text figures 1 to 3

EXPLANATION OF PLATES

PLATE 28

Section Euceanothus

A Branchlet with alternate leaves, thin, early falling stipules and umbel like clusters of flowers in racemes

B Fruit without apical horns.

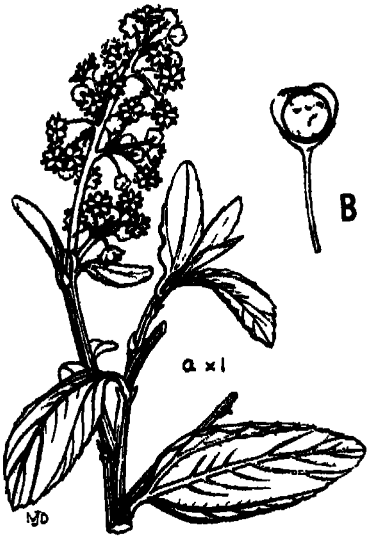
C Cross section of leaf showing stomata protected by guard cells on lower surface

Section Cerastes

D Branchlet with opposite leaves, thick, corky, persistent stipules, and umbel like fruit cluster

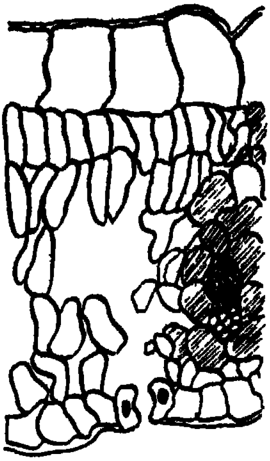
E Fruit with apical horns

F Cross section of leaf showing stomata in sunken pits on the lower surface



A

B



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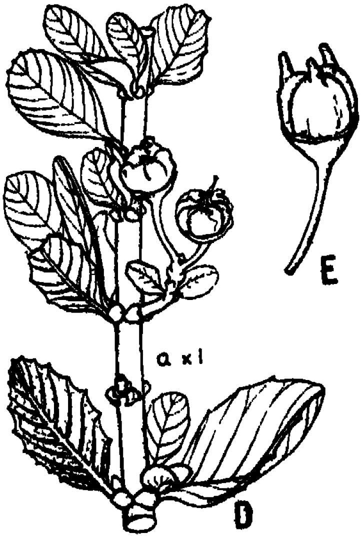
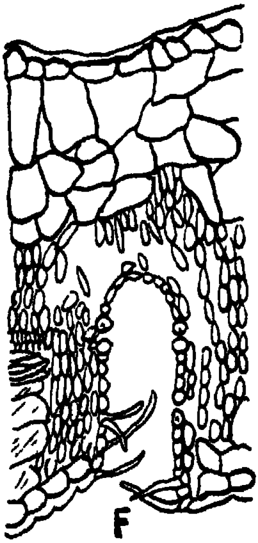


D

E



F

PLATE 29

Section Euceanothus

Fig 1 C *arboreus*

Fig 2 C *cordulatus*

Fig 3 C *cyaneus*

Fig 4 C *foliosus*

Fig 5, C *incanus*

Fig 6, C. *integerrimus* var *californicus*

Fig 7 C *Lemmonii*.

Fig 8 C *leucodermis*

Fig 9 C *papillosus*

Fig 10 C *Parryi*

Fig 11 C *Parryi*.

Fig 12 C *thyrsiflorus*

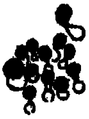
Fig 13 C *thyrsiflorus*

Fig 14 C *tomentosus*

Fig 15 C *velutinus*

Fig 16 C *velutinus* var *laevigatus*

Fig 17 C *spinosus*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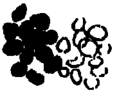
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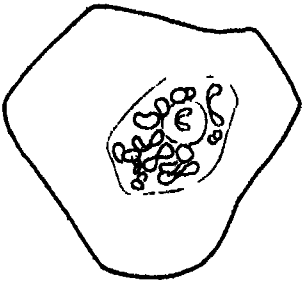
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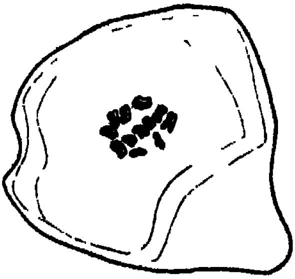
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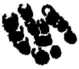
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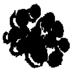
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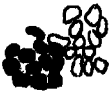
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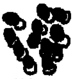
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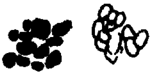
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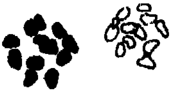
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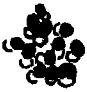
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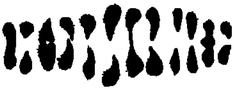
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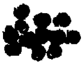
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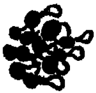
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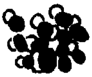
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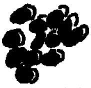


Fig. 16

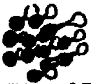


Fig. 17

PLATE 30

Section Cerastes

Fig 1 *C prostratus* var *occidentalis*
Fig 2 *C cuneatus*
Fig 3 *C cuneatus*
Fig 4 *C cuneatus*
Fig 5 *C cuneatus*
Fig 6 *C Ferrisae*
Fig 7 *C. gloriosus*

Fig 8 *C prostratus* var *laxus*
Fig 9 *C prostratus* var *laxus*
Fig. 10. *C prostratus*
Fig 11 *C ramulosus*
Fig 12 *C rigidus*
Fig 13 *C rigidus*
Fig 14 *C verrucosus*

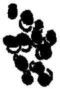
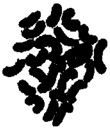


Fig. 1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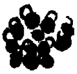
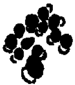


Fig. 11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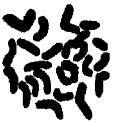
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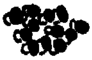
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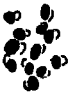


Fig. 3

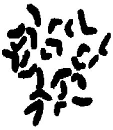
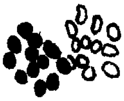


Fig. 8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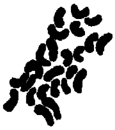
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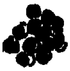


Fig. 9

Fig 14

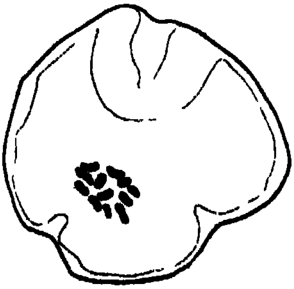


Fig. 4

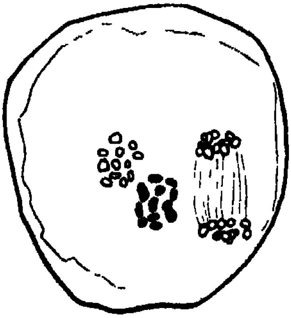
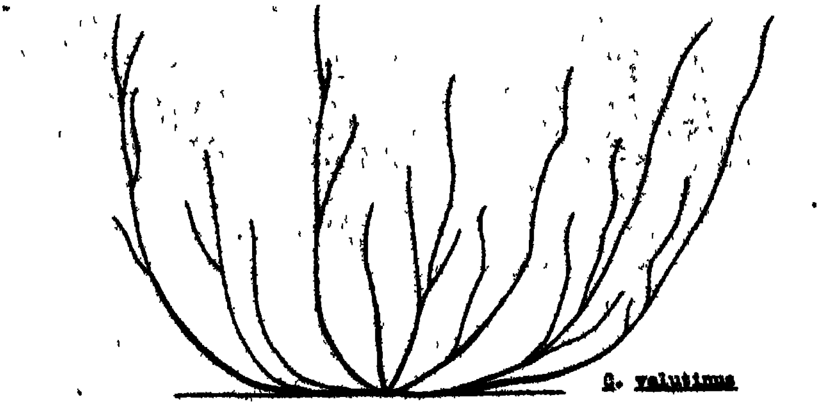


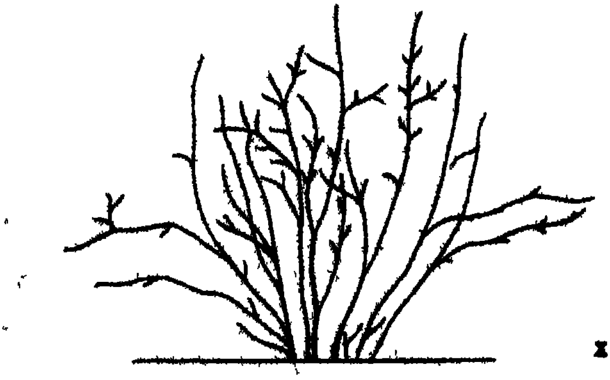
Fig. 10

PLATE 31

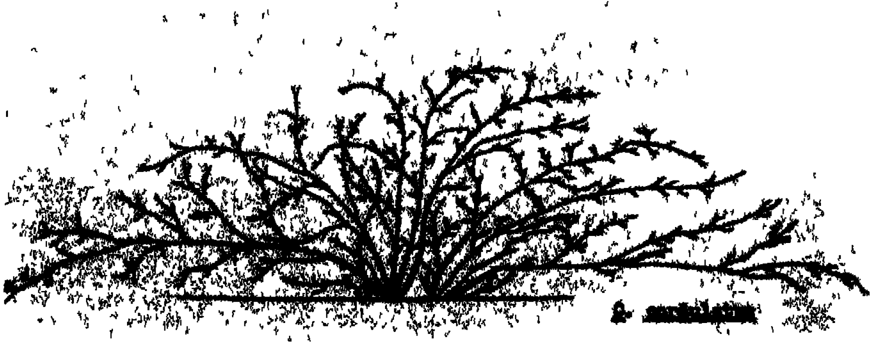
Diagrams of the growth forms of *C velutinus*, *C cordulatus*, and the hybrid × *C Lorenzenii*



C. *velutinus*



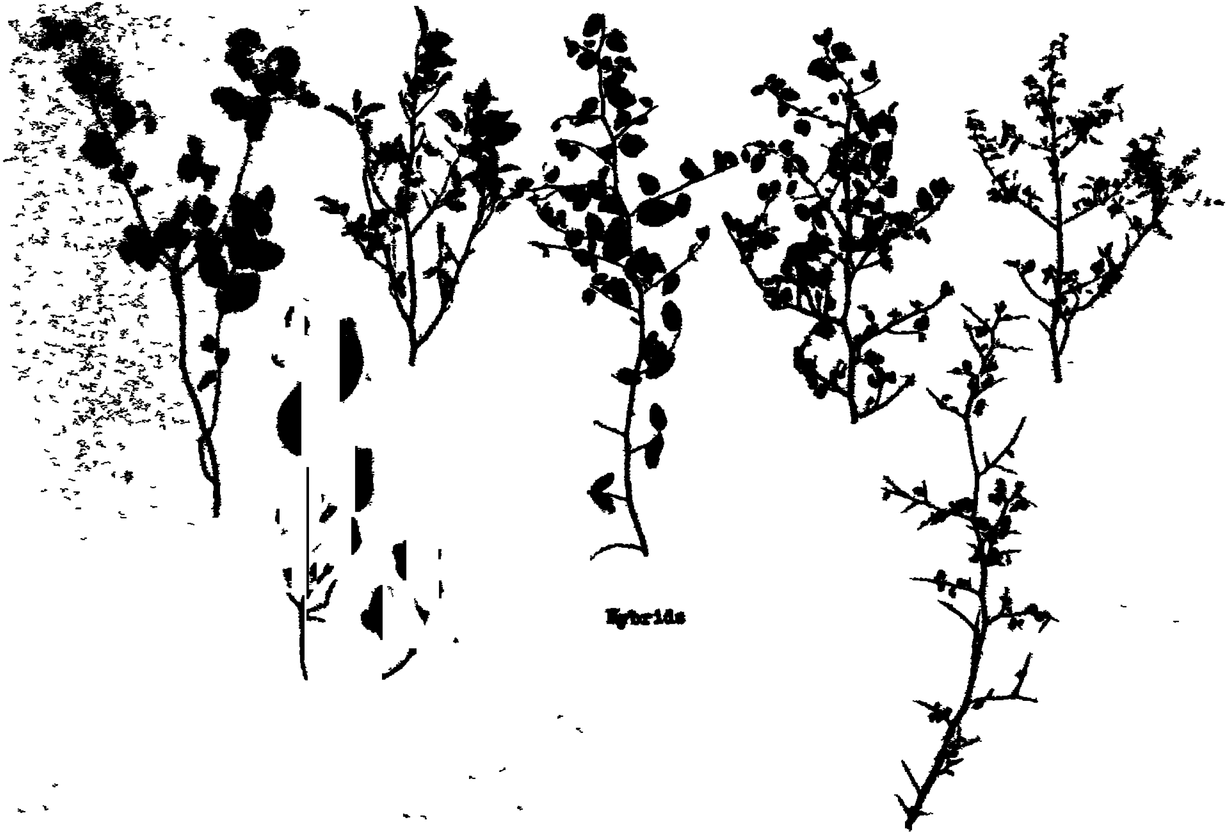
X C. *Lorenzenii*
(hybrid)



C. *cordulatus*

PLATE 32

Photographs of specimens of *C velutinus*, *C cordulatus*, and a graded series of five of their hybrids taken from an area where the two species occur together



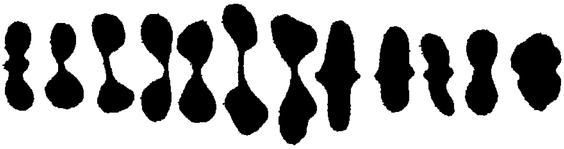
C. velutinus

Hybrids

C. cordulatus

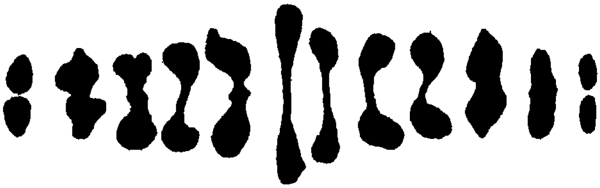
PLATE 33

Chromosomes of C *cordulatus*, C *velutinus*, and of the hybrid × C *Lorenzenii* C *cordulatus*, Nobs 76, Snow Flat, elevation 4500 feet, Nevada County, California, 12 regular pairs C *velutinus*, Nobs 79, Agate Bay, Lake Tahoe, Placer County, California, 12 regular pairs × C *Lorenzenii*, Nobs 117, Observation Point, Lake Tahoe, Eldorado County, California, 12 regular pairs. × C *Lorenzenii*, Nobs 118, Observation Point, Lake Tahoe, Eldorado County, California, 12 regular pairs, one very small pair, and 3 fragments



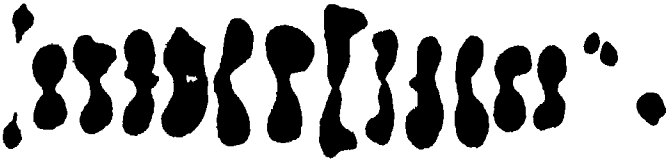
C. cordulatus

No. 117



x C. Lorenzenii

No. 118



C. velutinus

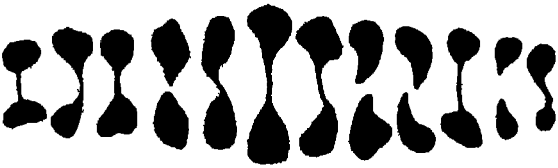


PLATE 34

Photographs of specimens of *C thyrsiflorus*, *C papillosus*, and a graded series of five of their hybrids taken from an area where the two species occur together

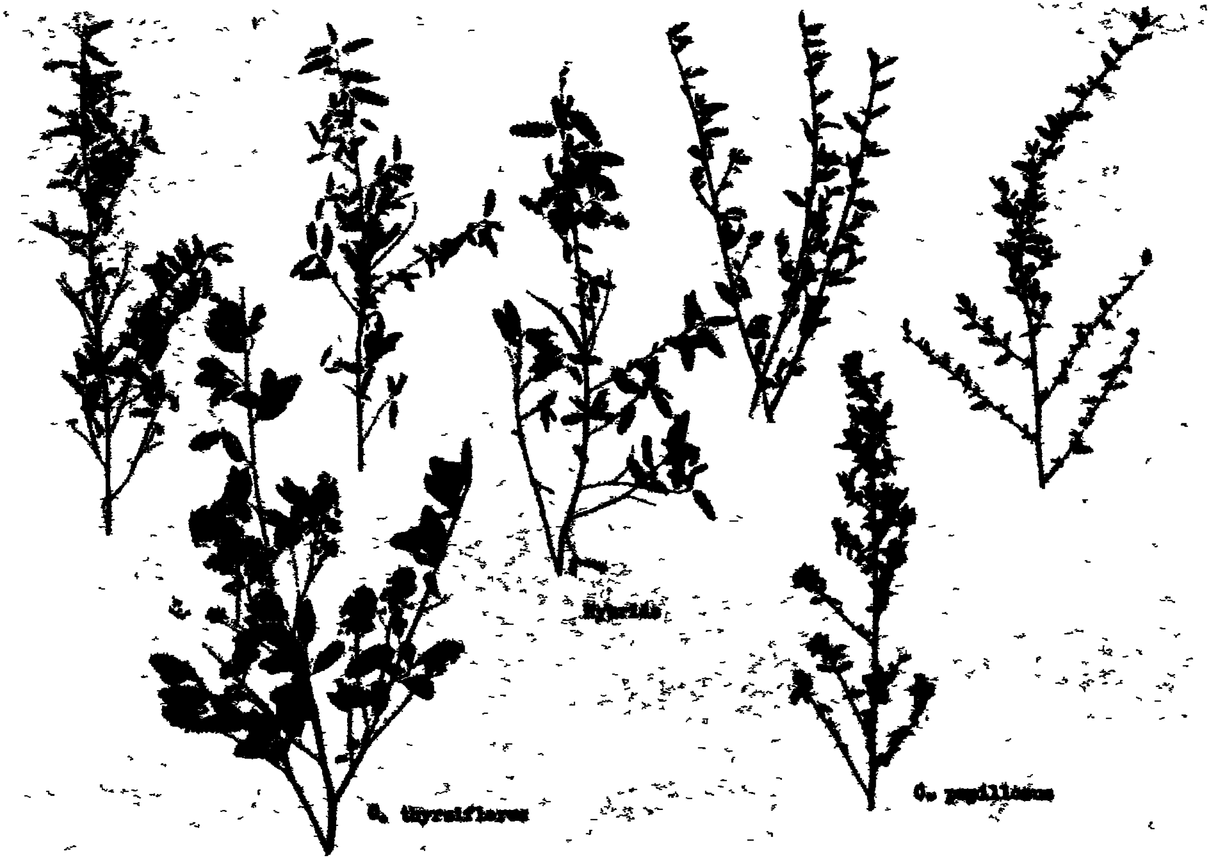

Hybrids
C. thyrsiflorus
C. papillosus

PLATE 35

Photographs of specimens of *C prostratus*, *C cuneatus*, and a graded series of four of their hybrids taken from an area where the two species occur together

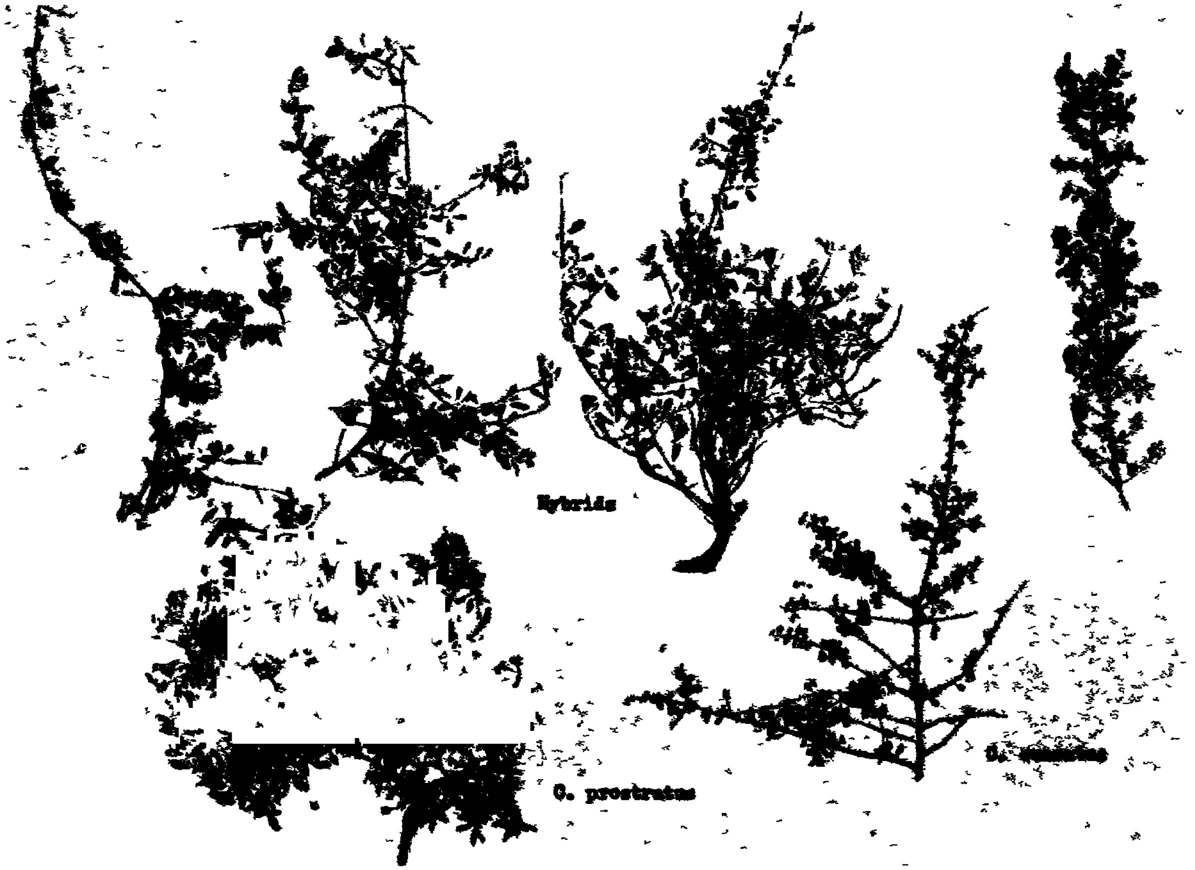
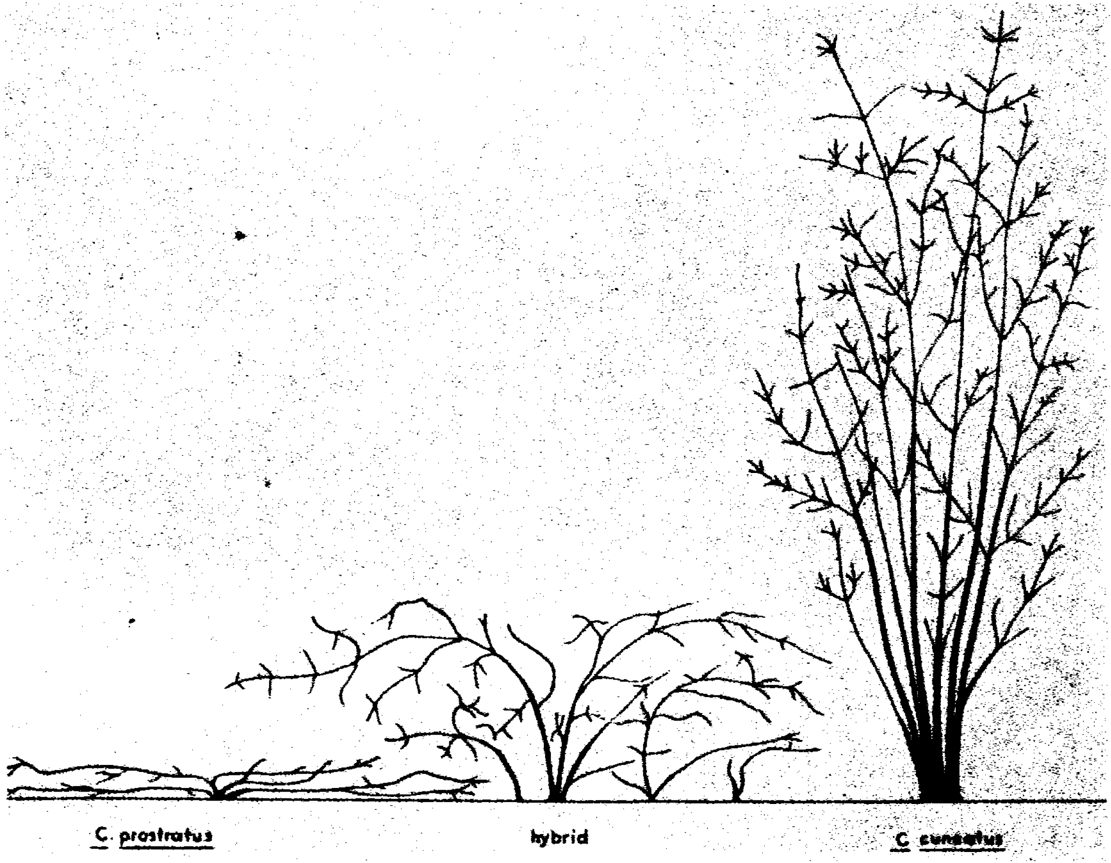

Hybrids
C. prostratus
C. [illegible]

PLATE 36

Diagrams of the growth forms of *C. prostratus*, *C. cuneatus*, and one of their hybrids.


C. prostratus
hybrid
C. cuneatus

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SEMI-CENTENNIAL PUBLICATIONS

No. 15

A REVISION OF PHACELIA SECTION MILTITZIA

BY

JOHN THOMAS HOWELL
Assistant Curator, Department of Botany
California Academy of Sciences

INTRODUCTION

THE SPECIES which are here presented as the section *Miltitzia* of the genus *Phacelia* have formerly been treated either as constituting the genus *Miltitzia* A DC or as forming the more numerous part of the genus *Emmenanthe* Benth (*Emmenanthe* § *Miltitzia* A Gray) I have recently expressed my belief that there is definitely a generic break between *Miltitzia* and *Emmenanthe* but that *Miltitzia* exhibits both morphologically and habitally a relationship so close to *Phacelia* sect *Microgenetes* that it should be treated as a section in *Phacelia* (1944, pp 12–16) The plump, corrugated seeds found in sect *Miltitzia* are like those in sect *Microgenetes*, while the compressed reticulate seeds of *Emmenanthe* are different from any in *Phacelia* Moreover the lateral attachment of the ovules to fleshy placentae in *Miltitzia* is characteristic of *Phacelia*, while in *Emmenanthe* the pendent ovules are basally attached to the wing-like margins of membranous placentae The marcescent persistent corolla, by which the species of sect *Miltitzia* may be distinguished from those of sect *Microgenetes*, was the character by which *Miltitzia* was separat from *Phacelia* although the character was not finally diagnostic since seve species in *Phacelia* sect *Eutoca* also have persistent corollas Although ı this corolla character which *Miltitzia* and *Emmenanthe* have in common, *'itsia* other structural characters of *Miltitzia* are entirely *Phacelia*-like and indica roc a relationship to *Phacelia* that must be interpreted as sectional rather th. r generic.

The section *Miltitzia* consists of only nine species and these are confined to the desert areas of the western United States between the Rocky Mountains on the east and the Sierra Nevada and Cascade Range on the west, extending northward to latitude 45° N or thereabouts and southward to about 35° N In this relatively limited area, the northern part of Nevada is not only the geographic center for the distribution of the species, but is also the center for species concentration Here are found seven of the nine species, while in adjacent southeastern Oregon are five and in eastern California four To the eastward not more than two species are found in any one state Three of the nine species are relatively common and widespread, *P adenophora*, *P scopulina*, and *P tetramera;* two are more localized in distribution and less common, *P inundata* and *P lutea,* four are to be counted among the rarest of western plants *P glaberrima,* known only from three collections, *P inyoensis* and *P submutica* known from a few collections from restricted areas, and *P salina,* known from five stations in three different states

Even to the present, there has been considerable confusion and not a little difficulty in limiting species, part of this being due without doubt to the meagerness of collections available for study A critical examination of numerous specimens assembled from various collections and institutions has revealed a series of mostly clear-cut and readily defined entities Habit, foliage, and vesture have been found quite variable within species so that plants unlike in aspect are sometimes referable to the same species because of the critical but dependable characters in flowers and fruits Because so little is known about the field occurrence of the subspecific variants, only a single variety has been recognized taxonomically, but undoubtedly others will be recognized as the variants become better known *Phacelia adenophora*, *P lutea,* and *P scopulina* are the only species presenting facies so polymorphic that they may be sometimes confused with related species The first, which may be considered the most primitive species in the group because of its larger flower-parts and hairy corolla-tube and filaments, is sometimes difficult to distinguish from *P lutea* and *P inundata* *Phacelia scopulina,* the most widely distributed species in the section, is also the most variable, to the west there are intergrades with *P lutea,* in the southeast *P submutica* is very closely related, and *P salina* seems to be merely an ecologically specialized variant with smaller parts

From a consideration of the environments in which these phacelias are found, it is very apparent that speciation in the group has produced entities which occupy several of the most highly specialized situations in our western deserts Thus *P inundata* is nearly confined to playas of evanescent ponds d shrunken lakes *Phacelia tetramera* and *P salina* are commonly restricted highly saline flats Although *P scopulina* is generally rather common in dy or gravelly soil of juniper slopes or sagebrush flats, it, too, sometimes curs locally in more alkaline situations *Phacelia adenophora* grows on sage- ush slopes, but in certain forms it is characteristic of clay flats of high plains The closely related *P lutea* seems to be characteristic of wash slopes of clay hills and valleys of eastern Oregon; and the highly localized *P inyoensis* seems to be confined to boggy spots among granitic sands bordering the

western Sierra. In no other group of like size in the genus are there so many forms edaphically specialized and localized, rare creations to thrill the soul of the botanical traveler who might chance upon one flourishing amid the vast loneliness and seeming desolate sterility of a saline desert

ACKNOWLEDGMENTS

This revision has been prepared in the Herbarium of the California Academy of Sciences (CAS), and, although the collection there has furnished the basis for research, my study would have been far from complete if I had not been able to borrow abundant collections from other institutions These institutions are here listed, together with the symbol used in citing specimens

Chicago Natural History Museum (CM)
Dudley Herbarium, Stanford University (DS)
Gray Herbarium, Harvard University (G)
Intermountain Herbarium, Utah State Agricultural College (IU)
Missouri Botanical Garden (M)
Greene Herbarium, University of Notre Dame (ND)
New York Botanical Garden (NY)
Pomona College (P)
Rocky Mountain Herbarium, University of Wyoming (RM)
University of California (UC)
United States National Herbarium (US)
Willamette University (W)
Washington State College (WS)

For the privilege of borrowing specimens, I am very grateful, and again I wish to express my gratitude and appreciation to many friends who have furnished me with field data and specimens in this group over a period of years Especially am I grateful to H D Ripley and R C Barneby for a complete set of their numerous excellent collections which they have obtained during the course of their critical field work in western American deserts from 1940 to 1944 The number of specimens cited from their collections in the present revision is indicative of the important contribution they have made to my study

Also it should be noted that because type specimens in the United States National Herbarium and in the Herbarium of the New York Botanical Garden are not available for study during wartime, some collections that are undoubtedly in those institutions are not cited in this paper

TAXONOMY

PHACELIA sect MILTITZIA (A DC) J T Howell, Leafl West Bot 4 15 (1944) *Miltitzia* A DC in DC Prodr 9 296 (1845) *Emmenanthe* § *Miltitzia* (A DC) A Gray, Proc Amer Acad 10 328 (1875)

Flowers 5-merous or occasionally 4-merous, corolla marcescent, yellow or frequently tinged with lavender or violet, corolla-scales present or lacking, filaments glabrous except in one species, ovary generally more or less pubescent, the style pubescent at least at base except in one species, ovules 4–26, laterally attached to fleshy placentae, capsule apiculate or muticous, seeds transversely corrugated —Annual herbs of saline or subsaline habitats in western North American deserts, herbage frequently fleshy, more or less pubescent and glandular, occasionally glabrous, stems branching and generally widely spreading, leaves entire to deeply pinnately divided

KEY TO THE SPECIES

A Corolla tube hairy inside between stamens, filaments hairy 1 **P adenophora**

A Corolla tube glabrous inside, filaments glabrous.

  B Seeds faintly but definitely transversely striate, the striations about 12, ovules 20–26 3. **P inundata**

  B Seeds prominently transversely corrugated, the corrugations 6–12, ovules 4–20

    C Corolla 5–8 mm. long, corolla scales generally conspicuous and united to base of filaments about 0 5 mm , style and branches (1 75 or) 2–3 75 mm long, hypogynous disk conspicuous with prominent rounded or deltoid lobes alternating with the stamens 2 **P lutea**

    C Corolla 1 3–4 5 mm long, corolla scales inconspicuous, obsolescent, or lacking, free from the filaments at base if present, style and branches 0 25–2 mm long

      D Plants glabrous or nearly so, corolla subrotate in anthesis, the lobes often about as long as the tube, ovary and style glabrous or nearly so 4 **P glaberrima**

      D Plants more or less hirsutulous or villous and capitate glandular or viscidulous, corolla campanulate, the lobes shorter than the tube (or about equaling the tube in *P. tetramera*), ovary generally sparsely to densely hairy, the style hairy at least at base

        E Flowers mostly 5 merous, corolla 3–4 5 mm long

          F Style and branches 1 25–2 mm long, hypogynous disk inconspicuous, ovules 10–15

            G Style hairy to above middle, capsule apiculate 5 **P scopulina**

            G Style glabrous except at very base, capsule nearly or quite without apiculation 6 **P submutica**

          F Style and branches 1 mm long, hypogynous disk relatively conspicuous

            H Ovules 18–20, seeds nearly 1 mm. long, the corrugations 6 or 7 7 **P. inyoensis**

            H Ovules 7–9, seeds 1 5–2 long, the corrugations about 9–11 8 **P salina**

        E Flowers commonly 4 merous, corolla 1 3–1 8 mm long 9 **P tetramera**

1 Phacelia adenophora J T Howell

Leafl West Bot 4 15 (1944)

Emmenanthe glandulifera Torr ex S Wats , Bot U S Geol. Explor 40th Paral (King's Exped) 257 (1871)

Miltitzia glandulifera (Torr) Heller, Muhlenbergia 8 20 (1912)

Miltitzia glandulifera (Torr) Heller var. *californica* Brand, Univ Calif Publ Bot 4 224 (1912)

Not *Phacelia glandulifera* Piper, Contrib. U.S Nat Herb 11 472 (1906)

Stems few or several, spreading from the top of the annual taproot, prostrate or strongly ascending, slender or rather stout, mostly 1–3 dm long, capitate-glandular and villous-puberulent or hirsutulous; basal leaves not very numerous and the upper leaves rather sparse, to 3 cm long and 1 7 cm wide, oblongish to subovate, pinnately lobed or divided, the lobes oblongish, obtuse, entire or rarely dentate-lobed, the uppermost leaves sometimes entire, hirsutulous and little glandular, petioles hirsutulous and glandular, to 2 5 cm long, racemes mostly exceeding the leafy part of the plant, to 1 dm long, sessile or nearly so, flowers somewhat distant below, congested above or the flowers on spreading or recurved pedicels, pedicels stout or slender, 1–3 mm long; flowers 5-merous, calyx-segments in flower 2–4 5 mm long, 0 4–1 mm wide, in fruit 5–6 5 mm long, 0 5–1 25 mm wide, linear to narrowly oblong-oblanceolate, sometimes a little spatulate, obtuse, hirsutulous and more or less glandular, corolla marcescent and a little accrescent, tubular to campanulate, yellow or the lobes more or less tinged with lavender, 4–7 mm long, lobes 1 25–2 mm long, outside of corolla hairy, inside sparsely to densely hairy in the tube between the stamens, corolla-scales 1–2 mm long, linear to narrowly semilinear-lanceolate, attached at base to base of filaments about 0 5 mm; stamens 3–5 mm long, somewhat unequal, the filaments hairy below the middle, anthers 0 5–0 75 mm long (or rarely shorter), styles and branches 2–4 mm long, the style hairy to the middle, branches 0 5–0 75 mm long, ovary 1 mm long, ovules 8–14, hypogynous disk relatively prominent, the lobes between the stamens broad and rounded, capsule 4–6 mm long, oblong to oblong-ovate, subacute to truncate below the terminal apiculation, longitudinally sulcate on backs of valves, sparsely puberulent, sometimes a little glandular above; seeds oblongish, 1–1 5 mm long, black-brown, prominently transversely corrugated, corrugations 8–12, rounded and mostly broad

Alkaline soil of high plains and sagebrush slopes, from middle western Nevada northward to northeastern California and southeastern Oregon

Representative collections NEVADA Virginia Mts, 5000 ft, *S Watson No 885* (G, type collection of *Emmenanthe glandulifera*); about 6 miles south of Gardnerville, Douglas Co, *Cantelow in 1941* (CAS, CM, IU, US), Carson City, Ormsby Co, *Anderson in 1865* (G, NY), Reno, Washoe Co, *M E Jones No 3986* (CAS, DS, G, IU, M, NY, P, RM, US), *Eastwood No 14773* (CAS, CM, P); 5 miles east of Sparks, Washoe Co, *Eastwood and Howell No 30* (CAS, US); Pyramid Lake, Washoe Co, *Kennedy No. 1037* (CM, DS, G, M, NY, RM, UC, US), 12 miles north of Reno toward Pyramid Lake, Washoe Co, *Ripley and Barneby No 4491* (CAS, G) In Gray Herbarium is a specimen labeled "Winnemucca Valley" collected by Lemmon in 1875, but the correctness of the locality is to be questioned

CALIFORNIA. Near Viewland, Lassen Co, *Ripley and Barneby No 5755* (CAS); 12 miles north of Susanville, Lassen Co, *J T Howell No 11884* (corolla-limb pale lavender fading to lavender-rose; CAS, US, W, WS), Horse Lake, Lassen Co., *J. T. Howell No 11892* (corolla bright yellow, CAS, CM, G, IU, M, ND), *J T Howell No 11898* (corolla-limb lavender, CAS, NY, P, RM), Madeline Plains, Lassen Co., *Bruce No 2135* (UC, type of *Miltitzia glandulifera* var *californica*), *Peirson No 6851* (CAS, P), *J T Howell No 11909A* (CAS, DS, W); canyon below Jess Valley, Modoc Co., *Payne No. 549* (CAS)

OREGON, Harney Co Catlow Valley, *Henderson No 8690* (CAS), Blitzen, *Train No 90* (US), base of Steens Mts, *Train* (Univ Colo) These collections from Oregon are not typical and show characters that vary toward *P lutea*

Phacelia adenophora is a rather variable entity, but it is usually well marked by the conspicuous pubescence on the filaments and in the corolla-tube In typical form as it occurs in middle western Nevada, it is a slender and somewhat elegantly branched plant with the upper parts rather finely hirsutulous and copiously capitate-glandular In the vicinity of Reno, Nevada, and to the northward, this typical variant passes by numerous intergrades into a coarser, more densely pubescent plant with flowers a little larger, the form which Brand called *Miltitzia glandulifera* var *californica* From southeastern Oregon relatively few collections of *P adenophora* are known, but, because the plants that grow there frequently exhibit characters intermediate to *P lutea* which also grows in the same region, it is suspected that the intermediates may be of hybrid origin

Although *P adenophora* is closely related to *P lutea* and perhaps should be considered only a variety of that species, I regard the differences between the two specific in value It is true that Asa Gray remarked that *P adenophora* (*Emmenanthe glandulifera*) was "probably a mere form" of *P lutea* (1878, p 171), but an examination of specimens in Gray Herbarium discloses that at that time he had no specimen of *P lutea*, and that he mistook for that species the more robust form of *P adenophora* which Brand has called *Miltitzia glandulifera* var *californica* Quite recently Jepson has treated *P adenophora* and *P lutea* as the same species (1943, p 281, as *Miltitzia lutea*), but each is characterized by a distinctive appearance and each by its own peculiar set of variations which do not approach each other except in instances of suspected hybridization I do not believe that there should be a change in the status of *P adenophora* until its relation to *P lutea* is clearly understood through more detailed study and critical field work.

Within *P adenophora* no variant seems sufficiently distinguished to be recognized taxonomically Although Brand's var *californica* of northeastern California has considerable right to varietal recognition, I have concluded that it is not clearly enough defined either geographically or morphologically to be accepted at this time Also I have seen several collections of a peculiar glandular-villous form with large flowers and slender fruits from southern Oregon which should perhaps be accorded taxonomic recognition, but, because of a possible connection which this plant may have with the imperfectly understood relations between *P adenophora* and *P lutea* in that region, nominal recognition of this entity, too, should await more numerous collections and further field work

A collection intermediate between *P adenophora* and *P lutea* is *Coville and Leiberg No 68* (US), from the road to Coleman Valley, Harney or Malheur Co., Oregon In it the corolla-tube is pubescent only at the base of the stamens, or glabrous, and the filaments vary from subglabrous to distinctly hairy Another intermediate collection from Oregon looking quite like *P adenophora,* but with the technical floral characters of *P lutea,* is *Willits No 169* (DS) from Hart Lake, Lake Co A collection of *P adenophora* which resembles *P lutea,* but which has heavily hairy corolla-tube and filaments, has been collected near Canby, Modoc Co, California, *J T Howell No 12215* (CAS)

2 **Phacelia lutea** (H and A) J T Howell

Leafl West Bot 4 15 (1944)

Stems one to several from the top of an annual taproot, spreading or ascending to substrictly erect, 2–8 cm long, hirsutulous and scarcely glandular to hirsutulous and capitate-glandular or almost entirely glandular-villous, leaves entire or coarsely serrate, rarely serrate-lobed, oblanceolate and oblong to elliptic and ovate, mostly 1–2 5 cm long, 0 3–1 cm wide, hirsutulous and a little glandular to sparsely glandular-villous, obtuse at apex, cuneate at base, petiole to 2 5 cm long, usually equaling or shorter than the blade, racemes to 5 cm long, sometimes more or less exceeded by and concealed by the leaves but generally exceeding the leaves and showy, pedicels 1–2 mm long or the lowest to 5 mm long, the lowest sometimes reflexed in fruit, calyx-segments in flower 3 5–5 mm long, in fruit 6 5–9 mm long, 1–1 75 mm wide, linear-oblong to narrowly oblong-oblanceolate, subacute, hirsutulous and more or less glandular to rather densely capitate-glandular, corolla yellow, sometimes becoming lavender-tinged in age, 5–8 mm long, campanulate or tubular, the lobes erect or spreading in anthesis, 1–2 mm long, denticulate, corolla sparsely hairy outside, glabrous inside, corolla-scales 2–3 mm long or sometimes obsolescent, semilinear-lanceolate, attached at base about 0 5 mm to the filaments, stamens 3–5 5 mm long, filaments glabrous, anthers 0 4–0 75 mm long, style and branches 1 75–3 75 mm long, branches 0 25–0 75 mm long, style hairy only near the base or to above the middle, ovary 1 25–1 75 mm long, ovules 10–17, hypogynous disk prominent with conspicuous rounded or deltoid lobes between the stamens, capsule 5 5–7 mm long, oblong to elliptic, subobtuse, apiculate, the beak to 1 mm long, sparsely hairy and a little glandular, seeds 1–1.5 mm long, elliptic-oblong, subobtuse to subacute, brown, prominently corrugated, the corrugations about 9 or 10, conspicuously reticulate

Clayey and sandy slopes and flats in southeastern Oregon, occurring locally in western Idaho and northwestern Nevada

The type of *P lutea* was part of a collection of plants "gathered in the summer of 1837 by a friend of Mr Tolmie" at "Snake Fort, Snake Country." In the introduction to the Supplement of Botany of Captain Beechey's Voyage (p. 315), it is stated that "Snake Fort is built at the junction of Reed's River with the Snake [River], the position of which is in N. lat 44° 20′, long 116° W." On modern maps the name Reed's River does not appear and the latitude and longitude indicate a point considerably east of the Snake River On the map in Hooker's Flora Boreali-Americana, vol 1, however, Reed's River is given and from its position it is clearly the Boise River of the present day, the chief affluent of the Snake River from the east between the Payette River and the great bend of the Snake Hence, collections that have been available from northwestern Owyhee County, Idaho, may be regarded as topotypes of this interesting species that was first collected more than a hundred years ago.

As has been pointed out in the discussion of *P adenophora,* Asa Gray had no specimens of *P lutea* at the time he prepared his account of *Emmenanthe* § *Miltitzia* for the Synoptical Flora (1878) As is indicated by his annotations on specimens in Gray Herbarium, he did receive collections of *P lutea* from Cusick by the time the second edition was published (1886), but there is nothing in the supplement of the second edition concerning these specimens Cusick's plants, collected from three different stations under varying environments, were probably more confusing than helpful to Gray One part of the collection, *No 1233a,* from "sandy hillsides of Malheur and vicinity" is typical *P. lutea,* but *No 1233b,* "same locality but on heavy clay soil," and *No 1233c,* "barren valley in rather heavy soil," are quite different in appearance and were originally noted as probably *Emmenanthe parviflora* (*P inundata*) by Gray, and were more recently identified as *Miltitzia glandulifera* (i e , *P adenophora*) by Macbride Although these puzzling plants and others like them from Professor Peck's collections are definitely referable to *P lutea,* they vary toward *P scopulina* and present a problem of relationship that can only be indicated at this time These variants are discussed further under *P scopulina,* and under *P adenophora* the problem of intermediates between that species and *P. lutea* is discussed

One variant in *P lutea,* however, seems quite distinct and well deserving taxonomic recognition, a small-flowered plant with glandular-villous pubescence This variety may be distinguished as follows·

KEY TO VARIETIES OF *Phacelia lutea*

Corolla 6–8 mm long, style hairy to the middle or above .	var. *typica*
Corolla 5–6 mm long, style hairy only near the base	var *purpurascens*

2a. **Phacelia lutea** (H and A) J T Howell
var **typica,** nom nov

P lutea (H and A) J. T Howell, l c
Eutoca lutea H and A Bot Beech Voy 378 (1840) ; Hook Icon tab 354 (1841)
Miltitzia lutea (H and A) A. DC in DC. Prodr 9.296 (1845)
Emmenanthe lutea (H. and A) A. Gray, Proc Amer Acad 10.328 (1875)

Plants hirsutulous and scarcely glandular to moderately glandular-hirsutulous, generally yellowish-green, racemes mostly exceeding the leaves, corolla 6–8 mm long, showy, style sparsely hairy to the middle or above, 2 5–3 75 mm long.

Representative collections IDAHO Squaw Creek near Marsing, Owyhee Co, *Tucker No 1029* (CAS ex Univ Ida So Br)

OREGON · Harper, Malheur Co, *Peck No 20553* (CAS, W), *Henderson No 8689* (CAS), 5 miles south of Harper, Malheur Co, *Peck No 16104* (W, approaching var *purpurascens*), Rockville, Malheur Co, *Henderson No 8691* (CAS, depauperate), Sucker Creek, 30 miles north of Jordan Valley, Malheur Co, *Holmgren No 2306* (CAS, IU), Malheur Butte, Malheur Co, *Leiberg No 2043* (CM, G, NY, UC, US), 15 miles southeast of Blitzen, Harney Co, *Applegate No 5591* (DS, W); near Burns, Harney Co, *Lilla Leach in 1927* (W); base of Steens Mts, Harney Co, *Howell in 1885* (CM, G, NY, US), Unity, Baker Co, *Peck No 16186* (W), Paulina Creek northeast of Lapine, Deschutes Co, *Whited No 1679* (ND).

NEVADA · Virgin Valley, Humboldt Co. *L Kellogg in 1909* (P)

An unsual variant, entirely glabrous except for an occasional hair in the inflorescence and for a few scattered hairs and glands at the top of the ovary and on the lower part of the style, has been collected by Ripley and Barneby in Owyhee County, Idaho, where it grew on a "friable alkaline clay bank 24 miles southwest of Marsing" (*No 6153*, CAS, G, US) A few of the corollas were noted by the collectors as being tetramerous

2b **Phacelia lutea** (H and A) J T Howell
var **purpurascens** J T Howell, var nov

Glanduloso-villosa vix hirsutula, caulibus foliis rhachidibus et segmentis calycis valde purpurascenti-tinctis, foliis racemos plerumque superantibus, corolla 5–6 mm longa, stylo 1 75–2 5 mm longo, pilifero solum prope basin

Type. Herb Calif Acad Sci No 127399, collected in "chocolate soil" on high hills opposite **Humphrey's, Grant County, Oregon,** by L F Henderson, *No 5092,* April 30, 1925 There is a duplicate in Gray Herbarium Only one other collection entirely typical of var *purpurascens* has been seen *Cusick No 2634,* which was obtained "in red clay soil of Crook Co" (CM, G, M, ND, NY, P, RM, UC, US)

3 **Phacelia inundata** J T Howell
Leafl West Bot 4 15 (1944)

Emmenanthe parviflora A Gray, U.S Pacif RR Reports 6 84, tab 15 (1857)
Miltitzia parviflora (A Gray) Brand, Das Pflanzenr IV. 251 181 (1913)
Not *Phacelia parviflora* Pursh, Fl Amer Sept 1 140 (1814), nor *P parviflora* Phil., Anal. Univ. Chile 90 226 (1895)

Stems several, spreading or ascending from the top of the annual taproot, mostly 1–4 dm long, but the plants sometimes depauperate and the stems only 0.1–0.3 dm. long, finely glandular and somewhat hirsutulous; leaves rosulate and also rather numerous up to the ends of the branches, mostly 1–3 cm long and 0 4–1 5 cm wide, oblong to oblong-obovate, subentire to pinnately parted and divided, the divisions obtuse, mostly entire, oblong or deltoid-oblong, the terminal division largest and generally lobed, the basal divisions frequently small and discrete, petioles 0 5–2 cm long, finely glandular-hirsutulous, the blades finely hirsutulous and a little glandular beneath; racemes mostly exceeded by the leaves, to 12 cm long, the lowest flowers rather distant, the uppermost somewhat crowded, pedicels 1–2 mm long or the lowest to 4 mm long, erect or somewhat spreading in fruit, flowers 5-merous, calyx-segments in flower narrowly oblongish, 4 mm long, 0 6–1 mm wide, in fruit 6–10 mm long, 1–1 5 mm wide, linear-oblanceolate to linear-oblong, sometimes a little spatulate, obtuse, hirsutulous and a little glandular, corolla yellow, 4–5 mm long, the lobes rotately spreading in anthesis, becoming erect later, lobes about 2 mm long, pilose-hairy outside, glabrous within; corolla-scales narrowly semilinear-lanceolate, 1 25 mm long, at base free from filaments, or the scales obsolete, stamens quite unequal, 2–3 mm long, filaments glabrous, anthers roundish, 0 3 mm long, style and branches 1–1 25 mm. long, style hirsutulous nearly to the branches, branches 0 25 mm long, ovary 1 5 mm long, densely hirsutulous, ovules 20–26, hypogynous disk rather prominent with rounded lobes between the stamens, capsule 5 5–7 mm long, oblong, abruptly narrowed above into a prominent deltoid apiculation and persistent style, sparsely hairy below, sparsely hirsutulous above and on the beak, not glandular, seeds 1 5–1 75 mm long, subdeltoid, irregularly angled, mostly acute at the ends, tending to be strongly flattened, reticulate-pitted, finely but definitely transversely striate, the striations about 12–14

Summer-dried playas of desert lakes and sinks from middle southern and southeastern Oregon south to northeastern California and middle western Nevada

Collections Oregon Klamath Lake, Klamath Co, *Newberry* (G, type), Silver Lake, Harney Co, *Cusick No 2727* (CM, G, M, ND, NY, P, RM, UC, US, plant noted as having a "very disagreeable odor"), Steens Mts above Alberson, Harney Co, *Peck No 14217* (NY, W)

California east side of Clear Lake, Modoc Co, *J T Howell No 12357* (CAS, US), between Malin and Canby, Modoc Co, *M S Baker No 8307* (CAS), west side of Eagle Lake at Spaldings, Lassen Co, *J T Howell No 12510* (CAS, CM, DS, P, W)

Nevada · Swan Lake, Washoe Co, *Train No 3006* (IU, NY), Washoe Lake, Washoe Co, *M E Jones in 1897* (CAS, P), Franktown, Washoe Co, *Ripley and Barneby No 5947* (CAS)

Phacelia inundata is one of the more rarely collected species in the section *Miltitzia* Although three of the nine collections that have been examined have come from northeastern California, before this it has been reported only from southeastern Oregon and Nevada (Tidestrom, 1925, p. 448; Peck, 1941, p 593) Only a single specimen has been seen (*Peck No 14217*) in which the collection data indicate an environment away from a desert lake or sink, while the Californian collections which I made came from lake-bottom areas that had been covered with water in the earlier part of the season Because of its preference for so peculiar a habitat, *P inundata* appears to be one of the most highly specialized and advanced species in the genus from a physiological point of view Morphologically it is quite distinct, too, its nearest relative perhaps being *P lutea*

4 **Phacelia glaberrima** (Torr) J T Howell

Leafl West. Bot 4 15 (1944)

Emmenanthe glaberrima Torr ex S Wats, Bot U S Geol Explor 40th Paral (King's Exped) 257 (1871)

Miltitzia glaberrima (Torr) Brand, Das Pflanzenr IV 251 131 (1913)

Stems several, spreading from top of annual taproot, 3–20 cm long and probably longer, first internodes above the base very long, entirely glabrous, leaves 1–1 5 cm long, 0 4–1 cm wide, glabrous or with a few hirsutulous hairs on the margins and near the apex, broadly oblanceolate and ovate to broadly elliptic, entire or with 1 to few coarse serrations, obtuse at apex, narrowly cuneate at base and frequently a little decurrent along the petiole, petiole to 2 cm long below, very short above, racemes to 8 cm long, flowers approximate or rather distantly spaced, pedicels mostly 1–3 mm long, flowers 5-merous, calyx-segments in flower very unequal, 2 5 mm long, 0 25–1 mm wide, in fruit 4–5 mm long, 0 3–2 mm wide, oblanceolate to obovate, fleshy and with a prominent midrib near the base, glabrous or with a few short scattered hirsutulous hairs near the apex, corolla 3–4 mm long, subrotate in anthesis the lobes 1–3 mm long, becoming erect later, entirely glabrous within and without, corolla-scales obsolete, stamens 2 5–3 mm long, filaments glabrous, flattened at base, anthers 0 4 mm long, style and branches 1–2 mm long, the style glabrous, deltoid-subulate, compressed, the branches 0 5 mm long, ascending, ovary glabrous or sometimes with a few scattered hairs near the top, 1 mm long, ovules 4–10, hypogynous disk prominent about uniformly wide all around and not conspicuously lobed, capsule 4–5 mm long, ovate to elliptic, glabrous or nearly so, somewhat rounded above, prominently apiculate, valves coriaceous with conspicuous thickened margins, longitudinally sulcate, seeds 1 5–2 mm long, oblong or ovatish, prominently corrugated, corrugations rounded, reticulate, about 10 or 11

Phacelia glaberrima is a remarkable and localized endemic in the saline desert of north-central Nevada and, until it was rediscovered in the Reese River Valley in June, 1944, by H D Ripley and R C Barneby, it was known only from the collections of Sereno Watson made in 1868 on King's Expedition The three presently known collections are Humboldt Sink, 4300 ft, *Watson in May, 1868* (G, UC frag), Reese Valley, 5000 ft, *Watson in July, 1868* (G, UC frag); Reese River Valley 32 miles north of Austin, Lander Co, *Ripley and Barneby No 6186* (CAS, G, US) Concerning the highly specialized habitat of *P glaberrima,* Mr. Barneby writes as follows: "The Reese River Valley is not very exciting for the most part, one of those broad sterile valleys covered with sagebrush and with long fans of gravel leading into the hills, but at one point about 60 miles south of Battle Mountain the mountains close in and the river has to negotiate a short canyon Here the mountains are mostly volcanic, but there are localized occurrences of limestone, and these have been broken down by weathering into white bluffs of a stiff gravel and clay mixture impregnated with alkali On the sides of these bluffs, on which nothing else can exist, *Phacelia glaberrima* is abundant, its yellowish herbage very succulent and fragile and its abundant racemes of golden-yellow visible from afar Occasionally it seeds down into the washes and there was one spot where it was associated with *P scopulina* and *P gymnoclada,* the three species, so similar and yet so different, sometimes enlaced into small "trispecific" mats The corolla of *P. glaberrima* is very open-campanulate, almost rotate when fully expanded, and the leaves are occasionally crenate "

Although *P glaberrima* might be related to *P scopulina* because of its smaller corollas which are devoid of corolla-scales, this rare Nevada plant is probably much nearer *P lutea* and, in its subrotate corollas, it is reminiscent of the equally highly differentiated *P inundata,* a species which I have also related to *P lutea* Among the numerous and varied *Miltitzia* collections of Ripley and Barneby are remarkable glabrous forms of both *P lutea* and *P scopulina* but from these *P glaberrima* may be readily distinguished by the rotately spreading and deeply lobed corolla, the glabrous style, and the thick-rimmed valves of the capsule From Watson's collections I concluded that the ovary was glabrous as originally described but in the ample material of Ripley and Barneby it is apparent that the ovary is sometimes sparsely and minutely hairy near the top

Phacelia glaberrima has been reported from the Flax River (Little Colorado River) in northern Arizona, where it was supposed to have been collected by Newberry, but I have located no Arizona collection (cf Kearney and Peebles, 1942, p 737)

5 **Phacelia scopulina** (A Nels) J T Howell

Leafl West Bot 4 16 (1944)

Emmenanthe scopulina A Nels., Bull Torr Bot Club 25 380 (1898)
Miltitzia lutea (H and A) A. DC var *scopulina* (A Nels) Brand, Das Pflanzenr IV 251 131 (1913).
Miltitzia scopulina (A Nels) Rydb , Bull Torr Bot Club 40 479 (1913)
Emmenanthe dispar M E Jones ex Rydberg, Fl Rky Mts and Adj. Plains 708 (1917), as synonym of *Miltitzia salina*

Stems several from the top of an annual taproot, 2–10 cm long, spreading or ascending and tending to be erect, sparsely to rather densely hirsutulous, more or less cinereous, eglandulose or minutely viscidulous above, leaves oblanceolate to oblong or oblong-obovate, 1–3 cm. long, 0.5–1.5 cm wide, entire, serrate- or crenate-lobed, or rather deeply pinnately lobed, the lobes oblong, deltoid, or elliptic, the blade obtuse at apex, cuneate to rounded at base, hirsutulous, petioles to 4 cm. long, frequently longer than the blades, racemes rather few-flowered and more or less concealed by the leaves, to 4.5 cm. long, pedicels 1–6 mm. long, erect or sigmoid-spreading, or the lowest recurved in fruit, flowers 5-merous; calyx-segments 2.5–4.5 mm. long, about 0.5 mm. wide, linear-oblong, in fruit becoming 6–7 mm. long, 0.5–1 mm. wide, linear-oblong or linear-oblanceolate, obtuse, usually without a prominent raised midvein except at the base, hirsutulous, rarely capitate-glandular and perhaps sometimes a little viscidulous, corolla tubular-campanulate, somewhat accrescent in age, 3–5 mm. long, the lobes 0.75–1 mm. long, yellow or strongly tinged with lavender or violet, the outside hairy, the inside glabrous, corolla-scales inconspicuous or obsolete, filiform-linear, about 1 mm. long, free from the base of the filaments; stamens 2.5–3 mm. long, the longest frequently equaling the lobes of the corolla, filaments glabrous, anthers 0.3–0.4 mm. long, style and branches 1.3–2 mm. long, the branches 0.2–0.3 mm. long, the style hirsutulous-hairy to the middle or above, ovary 1–1.25 mm. long, ovules 11–15, hypogynous disk inconspicuous and scarcely lobed between the stamens, capsule 5–6 mm. long, oblong, obtuse or subacute at top below the prominent apiculation, hirsutulous-puberulent especially above; seeds oblong or oblong-ovate, 1.25–1.75 mm. long, brown, prominently corrugated, corrugations rounded, 9–11, reticulate.

Loose sandy or gravelly soil of desert flats and slopes, from southwestern Montana and Wyoming southward to western Utah and northern Nevada, and westward to eastern Oregon.

Representative collections. MONTANA: Melrose, Silver Bow Co., *Rydberg No. 2771* (NY, US).

WYOMING: Green River, Sweetwater Co., *A. Nelson No. 3056* (RM, type of *Emmenanthe scopulina;* G, M, US), *A. Nelson No. 4712* (CAS, G, M, NY, P, RM, US, WS), *M. E. Jones in 1896* (CAS, IU, M, NY, P, RM, US), between Eden and Big Piney, Sublette Co., *Payson and Payson No. 2576* (CM, G, M, NY, P, RM, UC, US).

UTAH: Dutch Mt., Tooele Co., *M. E. Jones in 1891* (P).

NEVADA: Wells, Elko Co., *M. E. Jones in 1930* (P), *Eastwood & Howell No. 330* (CAS, CM, DS, ND, US), *Ripley and Barneby No. 5524* (CAS), 25 miles north of Wells, Elko Co., *Holmgren No. 955* (CAS, IU, UC), foothills of Independence Mts. southeast of Tuscarora, Elko Co., *Ripley and Barneby No. 5551* (CAS); near Wendover, Elko Co., *M. E. Jones in 1929* (CAS, P), Cobre, Elko Co., *M. E. Jones in 1906* (CAS, P), *in 1907* (P), foothills of Schell Creek Range west of Connors Pass, White Pine Co., *Ripley and Barneby No. 6305* (CAS); Monitor Valley south of Lone Mt., Eureka Co., *Ripley and Barneby No. 6203* (CAS); 11 miles west of Eureka, Eureka Co., *Ripley and Barneby No. 6235* (CAS); Reese River Valley 32 miles north of Austin, Lander Co., *Ripley and Barneby No. 6187* (CAS).

OREGON: Harney Lake, Harney Co., *Henderson No. 8688* (CAS); 24 miles north of Wagontire, Harney Co., *Peck No 19394* (W, simulating atypical *P. lutea*), 8 miles west of Lakeview, Lake Co, *Peck No 15243* (W, more glandular than typical), south of Narrows, Harney Co, *Ripley and Barneby No 6088* (depauperate, CAS)

Although Brand considered *Emmenanthe scopulina* a variety of *Miltitzia lutea,* I can see no reason for following so conservative a procedure. *Phacelia scopulina* has a very distinctive appearance and is marked by excellent characters over a wide range, and, in a much more restricted range, *Phacelia lutea* is usually quite as distinct In eastern Oregon, however, where the ranges of the two species overlap, plants have been collected which are confusingly intermediate in appearance, although from the critical characters of the flower-parts, such specimens have been definitely referable to one species or the other A pair of such specimens has been collected by Prof M E Peck, *P lutea* coming from 7 miles east of Buchanan, Harney County (*No 20536,* W), *P scopulina* from 25 miles north of McDermitts, Malheur County (*No 20600,* W) A series of collections of *P lutea* accompanied by field notes made by Cusick in eastern Oregon and preserved in the Gray Herbarium would seem to indicate that some of the variations noted may be due to environmental conditions, but it seems likely that much of the variability results from the genetic makeup of the group and may be due to hybridization between *P lutea* and *P scopulina* Cusick's collections are more fully described under *P lutea*

Another collection of *P scopulina* that exhibits noteworthy variability was made by Ripley and Barneby in Humboldt County, Nevada (*No 4557*, CAS) In this collection there are two kinds of plants, one that is normally hirsutulous-pubescent throughout, the other that is quite glabrous except for a few scattered hirsutulous hairs on some of the leaves and for a few minute capitate-glands on the stems, calyx-segments, and upper part of the ovary Because the only known collections of *P glaberrima* were made in the northwestern part of Nevada not very far from the station where Ripley and Barneby found this odd variant, their plants were compared with specimens of *P glaberrima* The floral morphology of the two was found to be so unlike that it would be quite wrong even to suggest that the subglabrous individuals are intermediate between the two species

M E Jones distributed his 1896 collection of *P scopulina* made at Green River with the name *Emmenanthe dispar,* but apparently he never described the plant Although Rydberg published the name as a synonym of *Miltitzia salina,* as indicated above in the synonymy, he had correctly determined and annotated Jones' specimen in Herb N Y Bot Gard as *Miltitzia scopulina*

6 **Phacelia submutica** J T Howell, spec nov

Herba annua plus minusve glanduloso-hirsutula; caulibus paucis vel multis ex basi, patentibus vel suberectis, 2–8 cm longis, purpurascenti-tinctis, sparse vel subdense vestitis pilis et hirsutulis albis gracilibus et paucis capitato-glandulosis, foliis plerumque dispersis 0 5–1 5 cm longis, 0 2–0 8 cm latis,

elliptico-oblongis ovatis obovatisve, integris vel tenuiter crenulatis vel prominenter serrato-lobatis, apice obtusis, cuneatis basi, plus minusve hirsutulis, petiolo ad 2 cm. longo, sæpe quam lamina longiore, racemis circa 2 cm. longis, sæpe foliis brevioribus, floribus subcongestis vel infimis distantibus, pedicellis plerumque erectis vel adscendentibus, ad 6 mm. longis, floribus 5-meris, segmentis calycis ad anthesin 3.5–5 mm. longis, 0.3–0.5 mm. latis, in fructu valde accrescentibus, 6–10 mm. longis, 0.3–1 mm. latis, hirsutulis et capitato-glandulosis, basi calcariformi-angulata, costa prominenti, corolla tubulata, 3.5–4.5 mm. longa, dilute lutea, haud purpureo-tincta, pubescenti extus, intus glabra, lobis 1 mm. longis, crenulatis, squamis ad lineas reductis vel nullis, staminibus inclusis, 2.2–2.75 mm. longis, filamentis glabris, antheris 0.3 mm. longis, latioribus quam longioribus explanatis, stylo et ramis 1.25–1.5 mm. longis, stylo paulum pilifero tantum prope basin, ramis 0.2–0.25 mm. longis, ovario 0.75–1 mm. longo, hirsutulo supra, ovulis 10 vel 11, capsula 3–5 mm. longa, elliptica vel elliptico-ovata, apice rotundata, mutica vel brevissime apiculata, longitudinaliter dorso valvarum sulcata, sparse hirsutula superne, seminibus 1.5–2 mm. longis, subovatis vel ovato-oblongis, obtusis, nigro-brunneis, paulo angulatis, prominenter transverse corrugatis, rugis circa 12, profunde alveolato-reticulatis.

Type. No. 163032 in Rocky Mountain Herbarium, University of Wyoming, collected on May 19, 1911, at **DeBeque, Mesa County, Colorado,** by George E. Osterhout, *No. 4458*. There is a duplicate in Herb. N. Y. Bot. Gard. *Phacelia submutica* is known only from Osterhout's collections made at DeBeque, others being *No. 4726* (RM, frag. CAS) and *No. 5978* (RM, frag. CAS).

Although *P. submutica* is obviously related to *P. scopulina* from which it was undoubtedly derived, it may be readily differentiated by a number of distinctive characters that indicate, each in a small way, a separate specific entity. *Phacelia submutica* has a rather distinctive appearance which comes from its less leafy and more floriferous habit and which is also due to the less cinereous character of the pubescence. In *P. submutica* the fruiting calyx-segments are usually much more elongate, and while the pedicels of the lower flowers are reflexed or sigmoid-spreading in fruit in *P. scopulina,* they are mostly strictly erect or ascending in *P. submutica*. There is a noteworthy difference in the coloration of the corolla in the two species, too, that of *P. submutica* being yellowish, that of *P. scopulina* being more or less strongly tinged in age with lavender or violet. The stamens in *P. scopulina* equal or exceed the corolla-throat, sometimes in anthesis even exceeding the corolla-lobes, while in *P. submutica* the stamens are shorter than the corolla-throat. Although all these characters indicate real differences between *P. submutica* and *P. scopulina,* they are not so important either specifically or diagnostically as the characters that are found in the style, capsule, and seed. In *P. submutica* the style is glabrous except for a few hairs near the base, but in *P. scopulina* the style is hirsutulous-hairy to the middle or above, generally densely so. The capsule of *P. submutica* differs from the capsules of other species in this

section except *P. tetramera,* in that it is either entirely devoid of a terminal apiculation or has a very insignificant one. By contrast, the capsule of *P. scopulina* is prominently apiculate. The differences in the seeds, although small, are nevertheless appreciable: the seeds of *P. submutica* are usually larger and more finely and numerously corrugated, the corrugations are not so rounded and are more deeply alveolate-pitted, and the seed-cover is blackish-brown and tends to be iridescent.

Hence, although *P. submutica* is undoubtedly closely related to *P. scopulina,* I believe that it is an entity sufficiently distinguished to be accorded specific recognition.

7. **Phacelia inyoensis** (Macbr.) J. T. Howell

Leafl. West. Bot. 4: 16 (1944).

Miltitzia inyoensis Macbr., Contrib. Gray Herb., n. ser., 49: 41 (1917).

Stems erect or spreading, slender, one to several from the top of the taproot, 2–10 cm. tall, hirsutulous and finely capitate-glandular, leaves few and scattered, not concealing the flowers, 0.5–1.5 cm. long, 0.3–1 cm. wide, oblong to elliptic or obovate, entire to coarsely and pinnately few-lobed, subobtuse at apex, cuneate at base, hirsutulous and more or less finely capitate-glandular, petioles of basal leaves to 2 cm. long, those of the uppermost leaves only about 3 mm. long, racemes lax, loosely few-flowered, to 7 cm. long, the lowest flowers distant, the uppermost approximate, pedicels slender and spreading, 2–6 mm. long, hirsutulous and glandular, flowers 5-merous, calyx-segments in flower a little unequal, 2–3 mm. long, 0.4–0.75 mm. wide, linear to linear-oblanceolate, in fruit 3.75–6 mm. long, 0.5–1.3 mm. wide, linear-oblong to oblanceolate, somewhat spatulate, narrowed below to claw-like base, subacute, glandular and hirsutulous, corolla pale yellow becoming tinged with violet, tubular- or cylindric-campanulate, 3–3.5 mm. long, lobes erect, 0.6–1 mm. long, corolla-tube hairy outside to the base, glabrous inside, corolla-scales obsolete or present as a mere line about 1 mm. long, free from the base of the filaments, stamens 1.5–2.5 mm. long, filaments glabrous, anthers about 0.2 mm. long, wider than long after dehiscence, style and branches 1 mm. long, branches 0.2–0.25 mm. long, style glabrous except at the very base, ovary 1 mm. long, hairy above, ovules 18–20, hypogynous disk relatively prominent with roundish lobes between the stamens, capsule 3.3–4 mm. long, elliptic, rounded-obtuse, shortly apiculate, sparsely hirsutulous, valves shallowly longitudinally sulcate on the back, seeds nearly 1 mm. long, ovatish or deltoid-ovate, acute at apex, rounded at base, brownish, corrugations rather prominent, reticulate, 6 or 7.

Known only from Owens Valley, Inyo County, California.

Collections. Foothills west of Bishop, *Heller No. 8324* (G, type, CAS, DS, US), Big Pine, *K. Brandegee in 1913* (P); Lone Pine, *K. Brandegee in 1913* (CAS, P).

According to data accompanying Heller's collection, the habitat in which this rare species grows is "a small dry peat bog among the granite sands." Although it is quite a distinct species, it is probably most closely related to *P. salina* and through it to *P. scopulina*.

8. **Phacelia salina** (A. Nels.) J. T. Howell

Leafl. West. Bot. 4: 16 (1944).

Emmenanthe foliosa M. E. Jones, Zoe 4: 278 (1893).
Emmenanthe salina A. Nels., Bull. Torr. Bot. Club 25: 381 (1898).
Miltitzia foliosa (M. E. Jones) Brand, Das Pflanzenr. IV. 251: 131 (1913).
Miltitzia salina (M. E. Jones) Rydb., Bull. Torr. Bot. Club 40: 479 (1913).
Not *Phacelia foliosa* Phil., Anal. Mus. Nac. Chile 53 (1891).
Not *Phacelia salina* M. E. Jones ex Brand, Das Pflanzenr. IV. 251: 119 (1913), as synonym.

Stems short and stout or slender and spreading, 2 to several from the top of a slender annual taproot, 0.5–3 cm. or even to 6 cm. long, sparsely hirsutulous, eglandulose or minutely and sparsely capitate-glandular above and in the inflorescence; leaves entire, sinuate-wavy, serrate or pinnately few-lobed, 0.5–1.5 cm. long, 0.3–0.9 cm. wide, oblanceolate to elliptical or obovate, sparsely hirsutulous, obtuse, narrowly to broadly cuneate at base, frequently a little asymmetrical at base, petioles 0.5–3 cm. long, racemes exceeded by the leaves, laxly few-flowered and only slightly scorpioid, the flowers distant or tending to be congested near the ground at the base of the stems, pedicels 1–5 mm. long, straight or spreading, flowers 5-merous, calyx-segments in flower 2.5–4 mm. long, in fruit 4.5–6 mm. long, 0.5–0.75 mm. wide, linear to linear-oblong or linear-oblanceolate, sparsely hirsutulous and sometimes a little glandular, corolla yellow or tinged with lavender, tubular, 3–4 mm. long the lobes erect, 0.9–1.25 mm. long, the corolla hairy outside, glabrous within, corolla-scales generally lacking, if present filiform and about 1.5 mm. long, at base free from the filaments, stamens 1.5–2.5 mm. long, filaments glabrous, anthers about 0.25 mm. long, roundish, style and branches 1 mm. long, the branches 0.2–0.25 mm. long, style hairy only near the base or to near the middle; ovary 0.75–1 mm. long, ovules 7–9; hypogynous disk with relatively prominent rounded-deltoid lobes, the lobes alternating with the stamens and about 0.2 mm. long, capsule 3–4 mm. long, broadly elliptical or elliptic-ovate, obtuse and apiculate, sparsely hairy, the valves thin-chartaceous with thick conspicuous margins, back of the valves shallowly sulcate, seeds brown, 1.5–2 mm. long, acute or subacute at both ends, oblongish to ovatish, prominently corrugated, corrugations 9–11, broad and rounded.

Of rare and local occurrence in alkaline soil in southern Wyoming, western Utah, and northern Nevada.

Collections: Bitter Creek, Sweetwater Co., Wyoming, *A. Nelson No. 3105* (RM, type of *Emmenanthe salina*; CAS, G, M, US), *A. Nelson No. 4786* (NY); Deep Creek Valley above Furber, Tooele Co., Utah, *M. E. Jones in 1891* (P, type of *Emmenanthe foliosa*; CAS, DS, G, M, UC, US), in loose red sand, west end of White Pine Mts. below Little Antelope Summit, White Pine Co., Nevada, *Ripley and Barneby No. 3592* (CAS), Reese River Valley 6 miles northwest of Austin, Lander Co , *Ripley and Barneby No 5926* (CAS), east base of Railroad Pass, Lander Co , *Ripley and Barneby No 5932* (CAS)

There is considerable variation in the data accompanying the original collection of *Emmenanthe foliosa* The specimen in the Jones Herbarium at Pomona College which I am accepting as the type gives "Furber, Nevada," June 8, 1891, while a second sheet gives "Deep Creek, alkaline flats above Furber, Nevada " Data on specimens in Herb Calif Acad Sci and U S Nat Herb are "On Deep Creek, above Furber," Utah, June 8, 1891, and in Gray Herbarium in Jones' handwriting are "Deep Creek, Utah," June 4, 1891. The data given in the original description are still different "Deep Creek, Utah, June 6, 1891, altitude 5000 feet " After a careful study of the plants constituting these specimens, I have concluded that all are parts of one collection, and by reference to the "Botanical Exploration of Marcus E Jones from 1875 to 1919" (Ms), I believe the correct data for the collection to be Alkaline flats, Deep Creek Valley above (i e south of) Furber, Tooele Co , Utah, June 8, 1891 According to his journal (l c , p 19), Jones was at Fish Springs on June 4, at Ibapah on June 6, and at Furber on June 8

Phacelia salina is intermediate between *P scopulina* and *P tetramera*, the three species apparently representing a distinct phylogenetic line Morphologically *P salina* seems more closely related to *P. scopulina*, differing chiefly in the smaller size of most parts, but ecologically it is much nearer *P tetramera*, both species being usually restricted to highly alkaline or mineralized situations in desert regions *Phacelia salina*, *P inyoensis*, *P glaberrima*, and *P submutica* are to be counted among the rarest of western plants

9 **Phacelia tetramera** J T Howell

Leafl West Bot 4 16 (1944)

Emmenanthe pusilla A Gray, Proc Amer Acad 11 87 (1876)

Miltitzia pusilla (A Gray) Brand, Das Pflanzenr IV. 251 132 (1913)

Miltitzia pusilla (A Gray) Brand var *flagellaris* Brand, l c

Not *Phacelia pusilla* Buckl , Amer Jour Sci 45 172 (1843), nor *P pusilla* Torr ex S Wats , Bot U S Geol Explor 40th Paral. (King's Exped) 253 (1871)

Stems several from the top of the taproot, spreading or ascending, 2–10 cm long, slender, finely glandular-villous and near the base sparsely hirsutulous, leaves narrowly elliptic-oblong to oblong-oblanceolate, 0 4–1 5 cm long, 0 2–0 7 cm wide, entire or saliently few-serrate-lobed, obtuse, narrowly cuneate at base, sparsely hirsutulous, petiole 0 4–1 5 cm long, glandular-villous, racemes to 8 cm long, very laxly flowered, the lowest flowers distant, pedicels to 4 mm long, slender, recurved or spreading in the lower flowers, flowers usually 4-merous, sometimes 5-merous, calyx-segments in flower 2 5 mm long, oblong or narrowly oblong-ovate, in fruit unequal in width, 4–5 mm long, 0 5–1 mm wide, narrowly to broadly oblong, hirsutulous and sparsely and minutely glandular, obtuse, united at base sometimes as much as 2 mm, the base cuneate; corolla whitish, 1 8–1 8 mm long, campanulate, the lobes erect, 0 5–1 mm long, the lobes sparsely hairy outside, glabrous inside; corolla-scales none, stamens 1 mm long, filaments glabrous, anthers roundish, nearly 0 2 mm across, style 0 25–0 4 mm. long, the branches indicated only by an emargination at the top of the style, ovary roundish, 0 75 mm long, hirsutulous at top, ovules 20, hypogynous disk narrow and inconspicuous; capsule oblong to oblong-obovate, 3–4 mm long, very obtuse, shortly apiculate or muticous, sparsely hirsutulous, the very base sometimes a little inferior; seeds 1 mm long, narrowly ovate to quadrate, round at base, acute at apex, light brown, finely and sometimes indistinctly corrugated, corrugations about 7–9

Alkaline flats and washes of high valleys, eastern Oregon south to central Nevada and eastern California

Representative collections OREGON Union Co , *Cusick No 758* (CM, G, US; first-cited collection of *Miltitzia pusilla* var *flagellaris*) , Malheur River, Harney or Malheur Co , *Cusick No 1946* (CM, G, M, ND, RM, UC, US, WS) , Wagontire, Harney Co , *Peck No 20844* (W) , 8 miles west of Lakeview, Lake Co , *Peck No 15243* (CAS, NY, W)

NEVADA 8 miles north of Twin Bridges, Elko Co , *Holmgren No 871* (IU, UC) , Steamboat Springs, Washoe Co , *S Watson* (G, type of *Emmenanthe pusilla,* NY) , Washoe Lake, Washoe Co , *M E Jones in 1897* (CAS, CM, DS, P, US) , Empire City, Ormsby Co , *M E Jones No 3987* (CAS, DS, IU, M, NY, P, RM, UC, US) , foothills of Toquima Range near Belmont, Nye Co , *Ripley and Barneby No 3696* (CAS) , northwestern Nevada, *Lemmon in 1875* (G) , Grass Valley, Lander Co , *Ripley and Barneby No 5920* (CAS)

CALIFORNIA "Sierra Nevada Mts ," *Lemmon in 1875* (US) , Chat, Plumas Co , *M E Jones in 1897* (CAS, P) , Long Valley, Mono Co , *J T Howell No 14382* (CAS, CM, G, IU, P, US) , valley east of Cedarville Modoc Co , *Ripley and Barneby No 6005* (CAS)

The earliest collection of this species, *Watson No 878* from Steamboat Springs, was included by Torrey in his *Phacelia pusilla,* and, although Gray cited Watson's collection in his original description of *Emmenanthe pusilla,* Brand annotated it in the U S National Herbarium as *Phacelia pusilla* Torr and cited it as that species in his monograph (1913, p 122)

The most remarkable feature of *P tetramera* is the tendency for the flowers to be 4-merous instead of 5-merous as is usual in *Phacelia* The reduction in the number of parts seems to result from the suppression of one part of the calyx, corolla, and androecium, and not to be due to the union of adjacent parts. Although most of the flowers that have been examined are truly 4-merous, occasionally they are either partly or completely 5-merous In some 5-merous flowers, the fifth calyx-segment is much smaller than are the other four; in one case two calyx-segments were united nearly throughout, while the other three were deeply divided It has been noted that 5-merous flowers are more numerous in specimens from Oregon than in those from California or Nevada. Certainly the reduction of flower-parts exhibited by *P tetramera* is a most unusual tendency in *Hydrophyllaceae*

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ENDEMISM IN THE HAWAIIAN FLORA, AND A REVISION OF THE HAWAIIAN SPECIES OF GUNNERA (HALORAGIDACEAE) HAWAIIAN PLANT STUDIES 11[1]

BY
HAROLD ST JOHN
Professor of Botany, University of Hawaii

ENDEMISM IN THE HAWAIIAN FLORA

ENDEMISM in its flora has long made the plants of the Hawaiian Islands famous Of the islands or floristic regions of the world having a flora of more than a few species, they are said to have the world's largest percentage of endemics.

Prof A Guillaumin (Proc 3rd Pan Pacif Sci Congr Tokyo 1 930, 1926) in his review of the Pacific island floras calculates that endemism for the Hawaiian Phanerogams is 66 per cent He does not state how he arrived at this figure but his totals of the species are evidently those of Wm Hillebrand This early botanist, Hillebrand (Fl Hawaiian Ids p XVII, 1888), calculated that of the native Phanerogams, 574 were endemic, while 246 only were indigenous, and 24 of early aboriginal introduction, and the total of native Phanerogams and Vascular Cryptogams was 860. It is apparent that Guillaumin used this total of 860 indigenous Vascular Plants and Hillebrand's figure of 574 indigenous Phanerogams in computing the percentage of endemism, which he calculated as 66 per cent Had he used 705 native species and 574 endemics, which are Hillebrand's truly comparable figures for the Phanerogams, the endemism would figure out as 81 per cent, which was the estimate of Hillebrand, previous to his death in 1886 All species published since that date or unknown to Hillebrand, Guillaumin seems to reject by his phrase that the area presents an extraordinary number of varieties which are sometimes considered as species of narrow geographic localization ("présente un nombre extraordinaire de variétés, considérées parfois des comme espèces et étroitement localisées ") D H Campbell used the same figures from Hillebrand, but he correctly calculated the endemism of Phanerograms as 81 42 per cent (The Derivation of the Flora of Hawaii, Univ Ser Stanford Univ , Publ 15, 1919) Also R Kanehira apparently used the same figures as he lists the Hawaiian endemism as 81 per cent (Proc 6th Pacif Sci Congr 4 610, 1940) Guillaumin concludes (pp 921, 931) that in the Hawaiian flora the Australian, New Zealand, and even Polynesian elements are almost completely lacking, that the flora has strong relationships with the American flora and should be considered a part of the Mexican floristic region The present writer disputes all of these conclusions of Guillaumin

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[1] This is the eleventh of a series of papers designed to present descriptions, revisions, and records of Hawaiian plants. The preceding papers have been published as Occasional Papers Bishop Museum 10(4), 1933; 10(12), 1934; 11(14), 1935, 12(8), 1936, 14(8), 1938; 15(1), 1939; 15(2), 1939; 15(22), 1940; 15(28), 1940, 17(12), 1943; Lloydia 7·265–274, 1944; Bull. Torrey Bot. Club 72·22–30, 1945.

The interpretations of C Skottsberg seem more truly in accord with the facts He divided the Hawaiian species of Phanerogams (Bull Bishop Mus 16 6, 1925) as 32 3 per cent Old-Pacific, 29 per cent Australian-Polynesian, 26 5 per cent Indo-Malayan, 7 5 per cent American, 3 3 per cent widespread, 1 2 per cent Subantarctic, and 0 2 per cent Boreal The widespread or Pantropic and the Subantarctic may well have immigrated by the same route as the other groups from Oceania If these, then, are all added, the total is 92 3 per cent for the plants with a probable southwestern origin that came or whose ancestors came as a stream of plant immigrants through Polynesia Later Skottsberg discusses the genera (Proc Linn Soc 151 182–186, 1939), their relationship, and probable route of immigration Of more than 200 genera, 18 are Pantropic, 15 Paleotropic, 49 Malesian, 12 littoral are widespread, 57 Austral, 22 Boreal, 9 aquatics apparently Boreal, and 13 Neotropical This review of the Hawaiian genera gives the same picture as with the species a large majority Indo-Malayan or Polynesian, small minorities Boreal and American

The same early source, Hillebrand, was used by J C Willis (Proc Linn Soc London 148 86–91, 1936) in his contemporary discussion of regional endemism Hillebrand's figures should not be discounted They were based on his excellent flora and were correct for his time, that is 58 years ago Still, to discuss the endemism of the Hawaiian flora today and to use only Hillebrand's figures is not the modern scientific method, which should use all available evidence Since 1886 in Hawaii there has been a great deal of arduous exploration of the rain forests and the precipitous mountains Here and elsewhere a large amount of floristic and monographic work has been published To overlook and reject all the work of C B Clarke, Heller, Rock, C N Forbes, Beccari, Léveillé, Skottsberg, Christensen, Degener, St John, Sherff, Yuncker, Christophersen, Caum, Hitchcock, Hochreutiner, Pilger, von Poellnitz, Radlkofer, Oliver, Danser, Heimerl, Keck, Krajina, Whitney, Hosaka, Fosberg, Egler, Lam, Croizat, Sleumer, and others, is not the way to arrive at a modern estimate of the known Hawaiian flora Skottsberg used the more sound method of including subsequent publications (Bull Bishop Mus 16 5, 1925) when he gave a tentative estimate of the indigenous Hawaiian Phanerogams as about 900 species Later he revised this figure to between 1,000 and 1,100 (Proc 6th Pacif Sci. Congr Berkeley 4 685, 1940) The writer keeps a check list of the Hawaiian flora There are quite a number of the recently proposed segregate species which he has not included, awaiting time to verify their status, but many will doubtless be accepted When eventually added in, they will increase rather than diminish the percentage of endemism At present the writer's figures for endemism of Hawaiian Phanerogams is 90 per cent, based on totals of 1795 indigenous, and 1614 endemic species and their subdivisions Estimates by some others exclude all subdivisions of species, but here each is included as a unit

Some Hawaiian genera contain species that are homogeneous and widespread, occurring unmodified on all or nearly all of the large islands Examples are given in the two following lists

I HOMOGENEOUS WIDESPREAD SPECIES IN GENERA MONOTYPIC IN THE HAWAIIAN ISLANDS

Freycinetia arborea Gaud
Joinvillea Gaudichaudiana Brogn and Gris
Dianella sandwicensis H and A [8]
Anoectochilus sandwicensis Lindl
Liparis hawaiiensis Mann
Habenaria holochila Hbd
Pilea peploides H and A
Argemone alba Lestib var *glauca* Prain
Osteomeles anthyllidifolia Lindl
Erythrina sandwicensis Degener
Strongylodon lucidus Seem
Plumbago zeylanica L
Osmanthus sandwicensis (Gray) B and H.
Nertera depressa Banks and Soland

II HOMOGENEOUS WIDESPREAD SPECIES IN GENERA WITH SEVERAL HAWAIIAN SPECIES

Smilax sandwicensis Kunth
Chenopodium oahuense (Meyen) Aellen[9]
Peperomia leptostachya H and A

There are other Hawaiian species widespread among the larger islands, but which are not homogeneous, having a tendency to vary These variations are in part recognized as described varieties but in large part are unrecognized, forming a part of the heterogeneous population now included in the species. Such ones are listed below

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[8] The recently described *Dianella lavarum* Degener and *D multipedicellata* Degener are considered exact synonyms

[9] *Chenopodium sandwicheum* Moq forma *macrospermum* Aellen and forma *microspermum* Aellen are not separable, as the larger and smaller seeds occur on a single plant.

III Polymorphic Widespread Species

- *Rumex giganteus* Ait
- *Charpentiera obovata* Gaud.
- *Charpentiera ovata* Gaud
- *Broussaisia arguta* Gaud
- *Acacia Koa* Gray
- *Ilex anomala* H and A
- *Cheirodendron Gaudichaudii* (DC) Seem
- *Vaccinium calycinum* Sm.
- *Vaccinium dentatum* Sm.
- *Styphelia Tameiameiae* (Cham) F Muell
- *Myrsine Lessertiana* A DC
- *Gouldia terminalis* (H and A) Hbd

Other genera, usually with many species, show a conspicuous segregation into species, usually each species being restricted to a single island or even to a single mountain range or valley on the particular island Such genera are the following

IV Genera with Numerous Species that are Narrow Endemics

Astelia, *Schiedea*, *Pelea*, *Fagara*, *Hibiscus*, *Viola*, *Labordia* *Haplostachys*, *Phyllostegia*, *Stenogyne*, *Cyrtandra*, *Coprosma*, *Hedyotis*, *Clermontia*, *Cyanea*, *Delissea*, *Lobelia*, *Bidens*, *Dubautia*, and *Lipochaeta*

The Hawaiian plants here listed illustrate a progressive series 1, genera monotypic in Hawaii occurring as invariable wides on all the principal islands, 2, species that are invariable wides, belonging to genera with several Hawaiian species, 3, species that are wides, but showing variability on the various islands, and 4, general with many Hawaiian species, typically with different, distinct species on each island These species represent degrees of increasing differentiation and presumably of decreasing age They show evidences of speciation The results of this species formation can be seen in the percentages of endemism here presented and discussed

REVISION OF THE HAWAIIAN SPECIES OF GUNNERA

One of the most famous of the genera occurring in the Hawaiian Islands is *Gunnera*, called by the natives "apeape " It is a giant herb with a stem 12 to 15 cm or more in diameter, fleshy, 2 to 6 meters tall, the base decumbent and prostrate The paired stipules are large, pale, and conspicuous From near the summit are produced several alternate leaves on fleshy petioles 6 to 13 dm long The blades are rounded, shallowly lobed, like great parasols 4 to 20 dm. in diameter Axillary panicles 8 to 10 dm long bear numerous minute green flowers and later tiny yellow, orange, red, or purplish drupes. The plant itself is so bizarre as to hold the attention and interest of all observers, whether scientific or not. Thus its occurrence is shown even on the tourist maps

The habitat of the "apeape" is also noteworthy. It occurs on precipitous slopes with the soil saturated from the run-off of the boggy mountain summits.

It is usually on the face or the foot of a precipice ("pali" in Hawaiian) and is often difficult of access It forms a definite vegetational belt between the Middle Forest and the Upper Forest, at anywhere from 2,500 to 5,000 feet altitude Because of the distinctive, giant leaves, this belt of "apeape," though narrow, is often so conspicuous that it can be seen from a distance of two or three miles

The "apeape" was discovered in 1819 by Charles Gaudichaud, who published it in 1830 as *Gunnera petaloidea* Subsequent collections have revealed that *Gunnera* occurs on Kauai, Oahu, Molokai, Maui, and Hawaii Hillebrand interpreted these as different locality records for the single species This has been the generally accepted view, that the same species occurred on all of the islands

The taxonomic history since the original publication by Gaudichaud has been brief Alphonse De Candolle described a specimen collected on Kaui [= Kauai] by the United States Exploring Expedition as *G petaloidea* Gaud *β Kauensis* A DC (De Candolle, Prodr Reg Veg 16(2) 597, 1868) His four word description included only two characters, almost glabrous, the bracts shorter We now find no differences in the Kauai plants in pubescence, and the bracts appear to be alike This plant was treated later as an unnamed variety, *G petaloidea* Gaud *β* (Hillebrand, Fl Haw Ids 124, 1888) In 1930 it was again distinguished by two botanists in almost simultaneous publications *Gunnera kauaiensis* Rock in Caum (Occ Pap B P Bishop Mus 9(5) 3–4, pl I, 1930, Sept) Rock described it from a new type specimen, Rock, 5,053 from Mt Waialeale The second author, Krajina, redescribed it as *G Dominii* Krajina (Acta Bot Bohemica 9 50, ill p 51, 1930, without precise date), citing as synonyms the varieties of De Candolle and of Hillebrand, but listing only his own collection from "montis Waialeale" It is apparent from the characters given below that this Kauai plant with peltate blades and red to purplish drupes is a distinct species Several attempts to learn from Prague the exact month and day of publication of Krajina's paper have failed A new search is being made for the date In the meantime, the name given by Rock is accepted as it is dated to the month

Krajina also described and illustrated from his own collections *G petaloidea* He published as two new varieties var *kaalensis* (p 50) from his collection on Puu Kaala, Oahu, and var *mauiensis* from his collection by Waikamoi Stream, east Maui Krajina apparently did not examine Gaudichaud's type specimen, nor did he indicate whether or not either of his two varieties was to be considered var *typica* though with a different name Duplicates of Krajina's collections have not yet reached the Bishop Museum, nor has the writer seen them in other herbaria Still, there is no difficulty in matching them Dr. V Krajina was a fellow at the Bishop Museum in 1929–30, a keen, energetic botanist who soon became my good friend and I took him on many field trips. His type of var. *kaalensis* was collected on my class trip to Puu Kaala at the well-known locality above the fire-brick trail from Schofield

Barracks My collection, St. John 10,072, was made at the same spot and time as Krajina's and there are numerous other collections from this locality His type of var *mauiensis* was collected at another often visited spot where the Olinda Pipe Line Trail crosses Waikamoi gulch There are several other collections from the same spot

That recounts the known taxonomic history of this genus in Hawaii The plant is known to all collectors and there are several standard, fairly easily accessible localities The writer has collected it on Kauai, Oahu, Maui, and Hawaii, but any new locality is always noteworthy On Oahu it has been repeatedly collected on the wet, windward side of Mt Kaala in the Waianae Mountains There are two or three collections from the drier, leeward side of the same mountain Also, Miss Marie Neal of the Bishop Museum tells the writer that she has observed *Gunnera* in the same mountain range on the adjacent peak, Puu Kalena, on its northeast or windward side

The preferred habitat is steep, water-soaked slopes on the windward side of a mountain range It has long puzzled the writer that the "apeape" was abundant in the Waianae Mts and not in the Koolau Range, the more easterly mountain chain on Oahu The Waianae Mts are rather arid, lying in the lee of the Koolau Range which gets the impact of the moist northeast trade winds and receives most of their moisture, while but little of it reaches the Waianae Mts Only the highest peak, Mt Kaala (called Puu Kaala on the earlier, 1917, official topographic map) gets a considerable rainfall It is just far enough to the north to receive the impact of the northeast trade winds which sweep over or past the descending, low, north end of the Koolau Range This is only about 1,000 feet high at this point, not high enough to cause the precipitation of all the moisture Hence, Mt Kaala with its large flat summit at 4,025 feet altitude and its upper ridges get enough rainfall to support a luxuriant rain forest The summit has a swampy forest except for some boggy openings near its center The average annual rainfall is now known to be 91 inches (Feldwisch, W E, First Progress Rept, Hawaii Territorial Planning Board 121, 1939)

The Koolau Range, Oahu, running from southeast to northwest, forms the backbone of the eastern side of the island It rises abruptly close to the shore, and the section above 1,500 feet in height extends for about 25 miles, making a barrier almost exactly at right angles to the prevailing northeast trades There are numerous sharp peaks that rise from the range, the highest being Puu Konahuanui with twin peaks 3,105 and 3,150 feet high The several rain gauging stations show a high rainfall, as this mountain range catches much of the moisture from the clouds The rainfall is more than 100 inches annually for most of this ridge and at the wettest station is 311 inches There are miles of wind-swept precipices ("pali") and steep slopes with much water seepage from the higher peaks, just the kind of habitat that usually supports *Gunnera*. The writer had botanized these brinks and declivities at many localities along the Koolau Range, and had never found the "apeape." Yet, this *Gunnera* is a plant that one cannot easily overlook With its bizarre leaves like huge umbrellas, it is always the biggest and most conspicuous plant in its area There were no specimens from the Koolau Range in the Bishop Museum, yet the plant has been reported from there Prof Vaughan MacCaughey listed it as rare in the rain forests of Manoa Valley (Am Journ Bot 4 600, 1917) In the same year in a short article about *Gunnera petaloidea* (Am. Journ Bot. 4 38, 1917, the reprints incorrectly printed vol 1) he stated that among its typical habitats were "Ka-ala and Kona-hua-nui summit ridges on Oahu (2,500–4,000 ft) " The 4,000 foot record is certainly that for the often visited station of Mt Kaala in the Waianae Mts Hence, we infer that his station on the 3,150 foot peak Puu Konahuanui was at about 2,500 feet altitude MacCaughey did exploring and original research in Manoa Valley which heads on the slope of Puu Konahuanui The plant is unmistakable, so there would seem no reason to question this record, yet corroborating specimens were much to be desired

Some years ago the writer had an enterprising young man as a student, John R Coleman He was enlisted in the United States Marine Corps and was stationed in Honolulu with a company doing guard duty at the docks At his request he was given continuous and regular night guard duty This left his day time free and enabled him to attend the University of Hawaii It was not obvious when he slept, but he did not sleep in class He completed the course on elementary botany and on week ends he often joined advanced classes on collecting trips to the mountains One Sunday he induced two other marines to join him, and from Nuuanu Pali they started to climb the knife-edged ridge that culminates in Puu Konahuanui As he led the way and scrambled up one precipitous slope, the bushes, soil, and all caved away He managed to make headway over the landslide and surmounted the ledge All the footholds were destroyed, so his companions could not follow, and turned back Coleman went on, climbed to the summit, and descended by a more southerly route The next day he brought me a 10 cm tip from a fruiting inflorescence with half ripe drupes, of a specimen that seemed to be *Gunnera* He reported collecting it near the summit on Oct 19, 1930 This specimen gave partial proof of the occurrence in the Koolau Range, but it was incomplete At last in June 1942 the proof was furnished by two students, L Eubank and A D Conger, who, on a wet day amid swirling clouds and rain, ascended Puu Konahuanui They observed and collected abundant and complete material They reported the three small colonies to be on the Manoa or leeward slope A second visit on Sept 13, 1942 by A D Conger, H St John, and R P St John was also in the clouds and intermittent rain, but thrice the clouds lifted to reveal the slopes, valleys and the shore line All three patches proved to be on the windward or Kailua side Any mountaineer will understand how in following forking, intricate ridges in dense clouds, one can lose track of the directions One locality was a single plant some 250 feet below the lower or south peak which is mapped and triangulated as Puu Konahuanui The two others were on the east face of a northeast ridge of the north or higher peak There were numerous plants in a steep, brushy, hanging valley at 2,950 feet altitude. Though both Miss Eubank and Mr Conger previously slid down the cloud-blanketed slope to the plants, then scrambled up again, on the second trip no one wanted to try it again. It was very dangerous, and when clear of clouds it was obvious that an uncontrolled slip on the steep, slippery clay would give one a flying start over the 1,000 foot precipice Later a fourth colony was located. On May 9, 1943 the writer conducted a student party of nine from Tantalus to the summit of Puu Konahuanui Clouds blanketed the precipices on the east slope hiding the single plant on the South Peak From the North Peak a descent was made down the secondary ridge towards Kailua The middle and inaccessible colony of *Gunnera* was again seen far below in the cloud Neither the writer nor his son Robert could locate the third colony, though this time a rope was at hand for a descent to it The clouds hid it completely Climbing up again, the descent was made along the main divide to the road at Nuuanu Pali On this divide a new colony was found, also on the east face, in a moist, precipitous, hanging valley at 2,300 feet altitude By the use of a rope the colony was visited and specimens collected There were more than 12 plants, up to 4 meters tall, some exposed, others half hidden by the thicket of *Pipturus albidus* and *Cyrtandra paludosa* The specimens collected have been deposited in the Bishop Museum These plants from the Koolau Range were critically compared with those from the east side of Mt Kaala in the Waianae Mts and were found to be identical in structure and quite inseparable, though the blades are smaller, the length along the midrib not exceeding 4 dm.

While investigating this material the writer took occasion to assemble all available specimens and to evaluate the species and varieties described from the other Hawaiian Islands by Rock and by Krajina Its massive fleshy stems, giant fruit clusters, and rounded leaves, 1 to 2 meters in diameter, cannot well be compressed upon a standard herbarium sheet, so that the collector is forced to take sample fragments which are inevitably incomplete, and the leaves selected are often the smaller ones Hence, all taxonomists revising the group and writing descriptions from the available herbarium material present measurements which are true as far as they go, but minimize the size of the giant stems, leaves, and inflorescences Several of the writer's whole numbers including many unmounted duplicates are available, but still there are gaps. From east Maui there are no mature stipules, and from west Maui there are no petals, and mature drupes and stones are needed from Molokai and from Makaha Valley, Oahu Still the collections are numerous and have proven sufficient At a glance they all look alike, but on close study differences are noted in the floral and fruiting morphology. It is curious that most of the characters are minute, a difference in shape to be seen with a lens or in size measured in fractions of a millimeter. Seedlings are often collected. Since they produce smaller stipules and blades that are much smaller and more reniform, they have not been included in our descriptions The only large parts furnishing characters are the stipules and the leaves as to lobing and toothing and pubescence When contrasted throughout, several correlated characters mostly of floral and fruiting anatomy are found When separated on these characters, the segregates are found to agree in leaf and stipule characters and to have good geographic correlations Each island has one local kind, except Maui and Oahu which have two each. When evaluated, the number and sort of characters would indicate that these segregates are properly considered species

The original species was *Gunnera petaloïdea* Gaudichaud (Voy. "Uranie," Bot 512, 1830) The plant was not illustrated and the 16 word description includes only the major features, but none of the ones now found serviceable in distinguishing the local species Neither Rock nor Krajina gave any discussion as to the nature of *G petaloidea* Gaud or its type locality. That published by Gaudichaud was "In insulis Sandwicensibus (Alt 450–500 hex) " No island is specified, and the statement of altitude in fathoms is unusual, but was perhaps natural after months at sea on a sailing vessel! Search has been made for any detailed itinerary of Gaudichaud He published none, and the narrative by the commander, Capt Louis de Freycinet, and those by other members of the expeditions give much on the physique and social habits of the native inhabitants, but nothing on the route of the collecting botanist On the "Uranie" voyage they spent 20 days in the Hawaiian Islands and Gaudichaud was on shore 7 days The writer has long marveled at the large number of the endemic species and genera that he collected and described on this first voyage Starting from the harbor, with no good roads, no cut mountain trails, to get up into the dense, native forests and through them to the cloud zone was a herculean task Then, over half of his collections were lost when the homeward bound ship was wrecked on the Falkland Islands All were soaked in sea water, but he rescued many by drying them before a bonfire on the beach These experiences are mentioned in a few brief words, but what stark tragedy they describe! What a grand naturalist he must have been, yet no portrait of him is known! He did not specify where his shore trips were made, but the ship made landings on Aug 8, 1819 at Kayakoua [Kailua, Hawaii], Aug 12 at Bay of Kohaihai [Kawaihae, Hawaii], Aug 17–25 at Raheina [Lahaina, Maui], Aug 26–30 at d'Onorourou [Honolulu, Oahu] So the seven days on shore were divided among these localities, but just how is not known In one day from the arid regions near Kailua and Kawaihae, it would not have been possible to ascend to the habitat of *Gunnera* on the far side of the Kohala Mts Hence, the island of Hawaii can be eliminated Back of Lahaina, Maui, the mountains rise abruptly from near the shore, and on the steep upper slopes of the valleys *Gunnera* is abundant From Honolulu it would have been possible to find *Gunnera* in either mountain range However, the east cliffs of Mt. Kaala were distant and difficult of access It is unlikely that he could have gotten there. Puu Konahuanui is only 6 miles in an air line from the harbor of Honolulu It is known that he climbed to the cloud zone at the crest of the Koolau Range, because he collected *Lobelia Gaudichaudii* which is restricted to that area Hence, it can be deduced that Gaudichaud probably collected the

Gunnera in the mountains of west Maui or in the Koolau Range near Honolulu, Oahu. In 1935 the writer photographed in Paris Gaudichaud's type specimen of *G petaloidea,* reproduced here as Pl 38 The data on the sheet read "90 Uranie, Ins Sandwich C Gaudichaud " Stipules are lacking and the pieces of the inflorescence do not permit one to detect the minute floral differences from the photograph However, the margin of the leaf is well shown The distinct, rounded lobes and the low, rounded teeth or crenations of the leaf margin match exactly those of the species of west Maui, so that it is to be taken as the type locality

The Hawaiian species all belong to the subgenus *Panke* (Molina) Schindler (Engler, Pflanzenreich IV, fam 225 117, 1905) This subgenus has a remarkable distribution, occurring also in the Cordilleras from Mexico to Chili, and on Juan Fernandez (Skottsberg, C , Proc 6th Pacif Sci Congr Berkeley 4 696, map 14, 1940)

In the ensuing systematic treatment are given key, diagnoses, and descriptions of the species as at present understood

All the specimens examined and cited and the new types are in the B P Bishop Museum, Honolulu, except the Gaudichaud type of *G petaloidea* which is in the Museum d'Histoire Naturelle, Paris

KEY TO THE HAWAIIAN SPECIES OF GUNNERA

- Blades peltate, drupes red to purplish 7 *G kauaiensis* Rock
- Blades basifixed, drupes yellow, orange (or reddish in *G mauiensis*)
  - Stipules scurfy on back or finally glabrate,
    - Petals entire, obtuse, glabrous, sepals 0 6–0 8 mm long, rounded, lacerate, anthers 1 2–1 3 mm long, peduncle bractless except at base, blade margin lacking mucros 5 *G kaalaensis* (Krajina) St John
    - Petals lacerate fimbriate, often acuminate, sepals 1–1 2 mm long, broadly deltoid, deeply lacerate, anthers 1 6–2 2 mm long, peduncle bracted, (stipules apparently scurfy), teeth of blade margin with revolute mucros 6 *G makahaensis* St John
  - Stipules not scurfy on the back,
    - Stipules glabrous,
      - Sepals 1 5–2 mm long, ovate, deeply lacerate, the lacerations fimbriate; petals entire 1 *G petaloïdea* Gaud.
      - Sepals 0 6–0 8 mm long, broadly deltoid to rounded, lacerate, petals minutely lacerate 2 *G molokaiensis* St John.
    - Stipules pubescent,
      - Petals 1 5 mm long, entire or somewhat erose, sepals 0 4–0.6 mm long, semioval, the obtuse tip minutely ciliate, anthers 1 9–2 mm long, elliptic oblong 3 *G mauiensis* (Krajina) St John
      - Petals 0 8–1 mm long, sparsely lacerate, sepals 1–1 2 mm long, oblong lanceolate, the tip lacerate, anthers 1 5–1 7 mm long, oval 4 *G Eastwoodae* St. John

1 **Gunnera petaloïdea** Gaudichaud

(Plate 37, fig d, pls 38, 39)

Gunnera petaloïdea Gaudichaud, Voy "Uranie," Bot 512, 1826 (= 1830)

Giant herb, 1–6 m tall, stem 2–5 m long, 15–22 cm in diameter, fleshy, often long decumbent, the surface with prominent leaf scars and many oval pits from which prop roots develop on older, mostly decumbent parts of the stem, roots reddish, slimy at tip, stipules 5–9 cm long, oblanceolate, pale, strongly nerved, glabrous, petioles 2–4 dm long, hirsute, swollen at the base, blades 27–53 cm long, cordate-reniform, shallowly palmately 9- or 11-lobed, firm chartaceous, dark green, glabrous or nearly so, impressed reticulate nerved, the veins sparsely hirsutulous, below the surface paler green, the veins even to the tertiary ones densely hirsute, the lobes 1 5–6 cm long, broadly deltoid, the midrib and prominent lateral veins each ending in a prominent deltoid dentation, the margin crenate or low rounded dentate, the sinus broadly V-shaped, inflorescence probably axillary, bracts at base of inflorescence 3-7 cm long lanceolate to oblanceolate, like the stipules, peduncle 5–16 cm long, hirsute, bractless, inflorescence 3–5 5 dm long, 12–25 cm in diameter, lanceoloid, hirsute towards the base, more or less glabrous towards the tip, the principal lower bracts 20–28 mm long, broadly linear, acute, the margin membranous, the lateral branches ascending or diverging, spiciform, flowers perfect, sessile, ovary barrel-shaped, calyx lobes 1 5–2 mm long, ovate, deeply lacerate, then the lacerations fimbriate, petals 1 5 mm long, obovate, cucullate, entire, glabrous, the 2 anthers opposite the petals, anthers 1 6–1 9 mm long, narrowly elliptic-oblong, the 2 stigmas 2 mm long, terete, densely puberulent throughout, drupes 2 5 3 mm in diameter, subglobose, greenish-yellow, stone 1 5–1 8 mm long, 0 9-1 3 mm wide, 0 9–1 mm thick, oval in outline, 4-angled, 4-sided, two of the angles prominent, the third less so, and the fourth still weaker and unequal, the stone laterally compressed, the surface dull, pale yellowish brownish

Type "In insulis Sandwicensibus (alt 450–500 hex) " The type specimen in Paris is labeled "90, Iles Sandwich, C Gaudichaud ' This is illustrated in our Plate 38

Collections studied, all from western Maui Eeka [of Hillebrand = Puu Kukui], ex herb Lydgate, *W Hillebrand and J M Lydgate*, gulch sides by Mt Kukui, Sept 24, 1916, *G C Munro 426* and *594*, Hanakaoo, shingles the valley sides in places, May 1910, *C N Forbes 69 M*, Olowalu Valley, central ridge, far up on the peak, large patches, May 21, 1920, *C. N Forbes 2,433 M*, without locality, *J F Rock and H*[*osmer*] *8215*

A discussion of the type locality is given in our introduction Gaudichaud could have discovered *Gunnera* either on Oahu or on western Maui Neither his publication nor the type specimen in Paris gives any hint as to the island concerned Luckily there are some differences in leaf shape, and by careful examination of the lobing and dentation of the leaf margin it has been possible to match the type with recent collections from near Lahaina, Maui Hence, it is deduced that Gaudichaud collected the type in the mountains back of Lahaina, Maui.

Most previous authors have combined under *G. petaloidea* all of the Hawaiian specimens This was due, doubtless in large part, to the fact that few if any of them had sufficient material to allow the recognition of any diagnostic characters between the specimens from the different islands. Consequently, their descriptions are mostly composite ones, so that one cannot now rely upon them. This also applies to the monographic treatment by A. K. Schindler (Engler's Pflanzenreich IV, fam 225.117, fig 34, 1905) The details that he shows in his figure 34 of the blade, petal, and anther agree with the characters of the common Oahu plant The entire, broadly triangular calyx lobes are different from any known Hawaiian plant, and it seems that they are incorrectly delineated He cited one by Gaudichaud and a total of six collections, originating from three islands, so it is quite possible that his drawing was a composite one made from several of these collections Hence, this Schindler drawing is considered to be in large part one of *G kaalaensis*, but not fully accurate

Gaudichaud in 1830, when he described *G petaloidea*, in a footnote deprecated his choice of a specific name which alluded to the presence of petals He had learned meanwhile that some other species of *Gunnera* had petals, but nevertheless he retained the name of *G petaloidea* since he had mentioned it already in his introduction (p 98) printed in 1827.

Most recent botanists have misspelled the named as *G petaloidea*, but Gaudichaud clearly published it as *G petaloidea*, spelling it thus with a diaeresis over the i to indicate a separation of the syllables, and spelling it consistently on two remote pages This was not an error, but rather his deliberate choice, so we must follow his spelling despite its strange appearance in a latinized name.

2 **Gunnera molokaiensis** St John, sp nov.

(Plate 38, fig e)

Herba gigantea, laminis 43 cm. longis cordato reniformibus 9 lobatis chartaceis infra pallidioribus nervis reticulatis hirsutulisque, lobis 5–8 cm. longis sinuato rotundatis denticulatis, inflorescentiis 15–40 cm longis lanceoloideis, ramulis spicatis, sepalis 0.6–0.8 mm. longis late deltoideis vel rotundatis laceratis, petalis 1 5 mm longis cucullatis spatulatis minute laceratis vel subintegris, antheris 1.5–1 9 mm. longis ovalibus, fructibus ignotis.

Giant herb , stipules 2 cm long, lanceolate, glabrous (?) , petiole (one seen) 47 cm long, with scattered dark pustules especially at base, densely hirsute at base, sparsely so to glabrate elsewhere, blade 43 cm long, apparently cordate-reniform, shallowly palmately 9-lobed, firm, chartaceous, above dark green, the surface and veins remotely hirsutulous to glabrate, below pale green, the prominent reticulate veins all scabrous hirsutulous, the lobes 5–8 cm. long sinuous rounded, the outline ovate, the sinus U-shaped, the margin irregularly rounded denticulate; inflorescence probably axillary; peduncle 7 cm. long (when young), bractless, tomentose towards the base; inflorescence 15–40 cm.

long, 4–15 cm. in diameter, cylindric to lanceoloid, tomentose on the axis and towards the base, glabrate above, the principal lower bracts 8–12 mm. long, linear-spatulate, the margin membranous, the lateral branches ascending, spiciform, flowers perfect, sessile, ovary barrel-shaped, glabrous; calyx lobes 0.6–0.8 mm long, broadly deltoid to rounded, lacerate, petals 1.5 mm. long, cucullate, spatulate, minutely lacerate or subentire; the 2 anthers opposite the petals, anthers 1.5–1.9 mm. long, oval, stigmas immature, drupes immature.

Type: **Molokai, Pelekunu Pali**, July 12, 1912, *C. N. Forbes 205 Mo* B. P. Bishop Museum, Honolulu.

Forbes was the only one to bring back *Gunnera* from the remote precipitous, windward brink of the Molokai mountains. His locality was on the old trail which started from Kamalo, ascended the broad ridge to the cabin near Puu Kolekole, then northeastward across the swampy forest and bogs to the divide near Kaunohua at about 4,535 feet altitude, then descended in switchbacks down the steep head wall on the north side. This deeply eroded Pelekunu Valley is a spectacular bit of mountain scenery. The *Gunnera* was probably found just below the windward or northern crest of the divide.

The writer has a record in his field notebook of observing *Gunnera* in Waikolu Valley, the next one to the west. More exactly this was at Hanalilolilo, near the head of the deeply eroded part of the valley. He did not get close enough to collect the specimens.

G. molokaiensis is most closely related to the species of western Maui, *G. petaloidea* Gaudichaud, which has the blades shallowly lobed, with lobes 1.5–6 cm. long, the margin crenate or low rounded dentate, the main veins beneath densely hirsute, the sepals 1.5–2 mm. long, ovate, deeply lacerate, the lacerations fimbriate, and the petals entire. *G. molokaiensis* has the blades with marked, well rounded lobes, the lobes 5–8 cm. long, the margin irregularly rounded denticulate; the main veins beneath sparsely tomentose to early glabrate, the sepals 0.6–0.8 mm. long, broadly deltoid to rounded, lacerate; and the petals minutely lacerate.

3. **Gunnera mauiensis** (Krajina) St. John, comb. nov.

(Plate 37, fig. g, pl. 40.)

Gunnera petaloidea Gaudichaud var. *mauiensis* Krajina, Acta Botanica Bohemica 9.50, figs. B_3, F_3, I_3, 1 pl. 1930.

Illustrations. by Bonine, in Rock, J. F., Monograph of the Hawaiian Lobelioideae, Mem. Bishop Mus. 7(2) pl. 34, 1919, by Krajina, see above, by Degener, O., Pl. Hawaii Natl. Park, pl. 66, 1930.

Giant herb about 2–3 m. tall, stem about 1–2 m. tall, the tip assurgent, the stem up to 6 m. in length and 15–20 cm. in diameter; bark near apex hirsute, with numerous glabrous, oval pits, where prop roots may later develop; terminal bud completely covered by the numerous imbricate stipules; stipules of seedlings 1.5–2 cm. long, ovate, membranous, strongly nerved, slender hirsute on the back, those of mature leaves 7.5–10 cm. long, elliptic-lanceolate with a broad truncate base, pale greenish, strongly nerved, sparsely puberulous base and tip, petioles 3–10 dm long, pustulate, densely hirsute at base, sparsely so elsewhere, blades 30–56 cm long, cordate-reniform, shallowly palmately 7–11-lobed, firm chartaceous, above dark green, remotely hirsutulous, soon glabrate, below pale green the prominent veins hirsute, the reticulate veinlets hirsutulous, the lobes 2–4 cm long, low rounded sinuate, the midrib and one or more principal lateral veins ending in low, deltoid dentations, the sinus broad U-shaped, the margin with low broad denticulations, inflorescence supra-axillary, bracts at base of inflorescence 5 cm long, oblanceolate, membranous, glabrous, peduncle 15–30 cm long, hirsute, bractless, inflorescence 4 3–10 5 dm long, 9–24 cm in diameter, lanceoloid, the axis hirsute, the principal lower bracts linear-spatulate, acute, with membranous margin, the lateral branches ascending, spiciform, hirsute at base, glabrous towards the tip, flowers perfect, sessile, ovary depressed globose, calyx lobes 0 4–0 6 mm long, semioval, the obtuse tip minutely ciliate, petals 1 5 mm long, broadly cucullate-spatulate, glabrous, entire or somewhat erose, the 2 anthers 1 9-2 mm long, elliptic-oblong, the 2 stigmas 2–3 mm long, densely puberulous, drupes 2 5–3 5 mm in diameter, globose, pale salmon-red, stone 1 6–1 9 mm long, 1 4–1 5 mm wide, 1–1 2 mm thick, broadly obovate in outline with three prominent angles of which one is lower due to a slight compression of the stone, and a fourth angle more or less developed or wanting, the surface pale yellowish brown, dull The fresh flowers are rose-magenta

Type "Maui Makawao District ad plurimos rivulos fluminis Waikamoi in declivibus septentrionali-orientalibus montis Haleakala, ca 1275 m s m, legi 15 IV 1930" *V Krajina* Herb Charles Univ, Prague, not seen

Collections studied, all from eastern Maui Olinda, along pipeline from Idlewild for about 7 miles in deep wet ravine, July 16, 1927, ***O Degener and H Wiebke 3,404***, the same, July 30, 1927, ***D L Topping***, herb ***Degener 8,185***, and June 19, 1927, ***O Degener and H Wiebke 2,240, 2,240a, 2,240b***, Kula Pipe Line, 4,000 ft alt, bank of Waikamoi Stream, Feb 11, 1930, ***H St John 10,302***, Waikamoi, rain forest, 4,250 ft, Aug 14, 1933, ***M Neal and C Hartt***, Haiku Uka, Waikamoi Gulch, steep side walls, 4,400 ft alt, Aug 4, 1943, ***H St John 20,358*** The foregoing are all from the same station on the pipe line trail east of Olinda Ukulele, Sept 4 1919, ***C N Forbes 1,255 M***, Haipuaena Stream, sides of wet valley, el, 4,400 ft, Nov 23, 1927, ***G C Munro 740***, below Koolau Gap, Haleakala, extremely rainy, wet region, June 17, 1927, ***O Degener 8,184***, Nahiku, Kuhiwa trail, Koolau Forest Reserve, 6,000 ft alt, wet woods, Jan 2, 1937, ***H St John and R J Catto 17,935***, Kipahulu Valley, northerly side gulch near head of Oheo Stream, wet thicket, 5,800 ft alt, Aug 22, 1945, ***H St John and A L Mitchell 21,104***

Most of the localities are in one general region, within a few miles of each other They are on the windward slope of Haleakala between 4,000 and 6,000 feet altitude Here in the very wet forests are numerous narrow gulches On their steep, often dripping side walls, the *Gunnera* is abundant

On the drier southeast side of Haleakala, *Gunnera* was reported in Kipahulu Valley by Mr David T Fleming In the summer of 1945 while exploring Haleakala for the National Park Service, it was possible for the writer to enter this area The upper section of Kipahulu Valley is well watered and densely forested, and the steep head walls are nearly always blanketed with clouds and very wet The stream heads have cut narrow gulches on the precipitous head walls and in these the *Gunnera* occurs from about 4,500 to 6,000 feet altitudes. It was found possible via Wai Anapanapa to approach one locality and get specimens These plants prove to be conspecific with those of the windward slope of Haleakala

4. **Gunnera Eastwoodae** St John, sp nov

(Plate 37, fig f, plate 42)

Herba gigantea 1.5 m alta, stipulis hispidis, petiolis 45–60 cm longis, laminis 38–53 cm longis cordato reniformibus parve 9 lobatis chartaceis infra pallidioribus nervis reticulatis hirsutulis lobis 8–10 cm longis rotundatis apice breve acuminato marginibus apiculato denticulatis, pedunculis 15–20 cm longis hirsutis, inflorescentiis 37–64 cm longis lanceoloideis axi primario tomentoso ramulis spicatis, floribus rubris, sepalis 1–1 2 mm. longis oblongo lanceolatis ad apicem laceratis, petalis 0 8–1 mm. longis obovatis cucullatis laceratis, antheris 1 5–1 7 mm longis ovalibus, drupis 3.5–4 mm diametro luteis, pyrena 1.6–1 8 mm longa 1.4–1 5 mm lata 1.1–1 2 mm. crassa late ovali obovoidea tetragona straminea

Giant herb, 1 5 m tall, stem stout and fleshy; stipules of seedlings 1 5–2 5 cm long, oval, erose, membranous, strongly nerved, sparsely hispid on the back, those of mature leaves apparently similar but narrower, petioles 45–60 cm. long, sparsely hirsute, blades 38–53 cm long, cordate-reniform, shallowly palmately 9-lobed, firm chartaceous, above dark green, remotely hirsutulous, the lobes 8–10 cm long, semicircular, the end of the midrib and one or more prominent lateral veins ending in short acuminations, the margin irregularly apiculate denticulate, the sinus broad V-shaped, below the surface pale green, prominently reticulate veined, subappressed hirsutulous on all the veins and veinlets, inflorescence probably axillary, bracts at base of inflorescence not seen, peduncle 15–20 cm long, sparsely hirsute, inflorescence 37–64 cm long, 10–15 cm in diameter, lanceoloid, the axis ferrugineous tomentose, bractless, the lateral branches ascending, spiciform, tomentose towards base, glabrous towards tip, the principal lower bracts 15–20 mm long, linear oblanceolate, the margin membranous, the flowers perfect, bright reddish, sessile, ovary ovoid truncate, calyx lobes 1–1 2 mm long, oblong-lanceolate, the tip lacerate, petals 0 8–1 mm long, obovate, cucullate, sparsely lacerate, the 2 anthers 1 5–1 7 mm long, oval, the 2 stigmas 3 mm long, filiform, densely puberulous throughout, drupes 3 5–4 mm in diameter, globose, yellow, seeds 1 6–1 8 mm. long, 1.4–1.5 mm wide, 1 1–1 2 mm thick, broadly oval-obovoid, the apex emarginate, 4-angled, but somewhat compressed, two angles equal, the third well developed upwards, the fourth weak, the surface dull, stramineous

Type: **Hawaii, Waipio, Upper Hamakua Ditch Trail,** 3,500 ft alt, on moist cliff, Jan. 1, 1932, *H St John and E. Y Hosaka 11,478* B. P Bishop Museum, Honolulu

Collections studied, all from the island of Hawaii · Waipio Valley, Upper Hamakua Ditch Trail, face of pali at head of valley, alt 1,300 m., Nov 19, 1926, *L H. MacDaniels 286*, Kohala Mts., Waimea, Sept. 7, 1911, *C. N Forbes 488.H*, Kohala, Oct 1931, *O. Degener*

3,183, Alakahi, Kawainui or Kawainui ditch or Kawainui Valley, July 12, 1909, *J. F. Rock, 129, and 4,374 or 4,375 or 4,376 or 4,382*, Waimea, Hawaii, June 1910. *J. F. Rock 8,432.*

The specimens with definite localities all came from the windward slope of the Kohala Mountains, a region of very wet, swampy forests, at the brink of the precipitous, deeply entrenched valleys Waimea is the nearest town, with hotel and supply base It is in open grasslands, not the sort of place where *Gunnera* grows Doubtless Waimea was the base camp of the collectors, not the habitat and locality of the plant Forest ranger Kawai reports another locality at the head of Honopue Gulch

Rock's collection in 1909 bears confusing data on the four sheets examined Alakahi and Kawainui are distinct valleys, both tributary to Waipio They diverge sharply, so it is not evident how the locality could be in both valleys Each of his sheets bears two numbers His number 129 is perhaps a trip number, while the others are apparently serial numbers given to each sheet collected Though bearing different numbers they are doubtless duplicate sheets Degener's locality Kohala is also open to question Kohala town, post office, and mill are in the lowland, remote from the area where *Gunnera* is known to grow Perhaps this locality is to be taken as a general one, referring to the Kohala District or Mountains

This new species is dedicated to Miss Alice Eastwood, Curator of Botany in the California Academy of Sciences Her many decades of creative work have enriched the science of botany, and her friendliness and generous assistance have endeared her to all botanists who have consulted her

5 **Gunnera kaalaensis** (Krajina) St John, comb nov

(Plate 37, fig c, plates 43, 44, 45)

Gunnera petaloidea Gaudichaud var *kaalaensis* Krajina, Acta Botanica Bohemica 9 50, figs F_3, B_2, Fl_3, P_2, A_3, 1930

Giant herb, stem 1–3 m tall, about 15 cm in diameter, decumbent at base, the surface marked with raised, pale, corky leaf-scars, and above them numerous oval, raised craters, stipules 4–8 cm long, lanceolate, scurfy on the back, membranous, strongly nerved, petioles 3–6 dm long, at first densely hirsute, later sparsely so, with scattered dark tubercles, blades 20–50 cm long, cordate reniform, shallowly palmately 7 9-lobed, firm chartaceous, above dark green, hirsute on primary and secondary veins or glabrate, below paler green, rough hirsute on the prominent, reticulate veins and veinlets, the lobes low undulate, shallow, rounded, 3–7 cm long, the sinus broad U-shaped, the margin coarsely salient dentate, inflorescence axillary, bracts at base of peduncle reduced, about 2 5 cm long, membranous, peduncle 7–12 cm long, bractless, hirsute but soon glabrate, inflorescence 15–47 cm long, 4–14 cm in diameter, narrowly lanceoloid, the axis hirsute or glabrate, principal lower bracts 10–20 mm long, linear-lanceolate, the margin membranous and not or but partly fimbriate ciliate, the lateral branches ascending spiciform, hirsute at base, glabrous towards tip, flowers perfect, sessile, greenish, ovary depressed globose, calyx lobes 0 6–0 8 mm long, rounded, lacerate; petals 1 3–1 8 mm long, spatulate-obovate, cucullate, entire, obtuse, glabrous, the 2 anthers 1 1–1 3 mm long, ovoid, the 2 stigmas about 2 mm long, densely puberulous, drupes 2 8–3 1 mm in diameter, globose, yellow, stone 1 8–1 9 mm. long, 1 4–1 6 mm wide, 1 3–1 5 mm thick, broadly oval-obovoid, the apex rounded or emarginate, with 4 prominent angles, the 2 lateral strongest and equal, the 3rd nearly as strong but diminishing at base, the 4th nearly as strong as the 3rd in the upper half, in the lower half nearly wanting, the surface yellowish brown, dull

Type· "Oahu Montes Waianae, in declivibus orientalibus sub summo montis Puu Kaala, 1150 m s m , legi 24 XI 1929" [*V Krajina* in Herb Charles Univ , Prague, not seen]

Collections studied, all from Oahu, Waianae Mts , Mt Kaala Kaala Mts , *H Mann and W T Brigham 626*, Mt Kaala, Jan 1920, *E Bryan*, Mt Kaala, elev 3,200 ft , Feb 11, 1928, *H F Bergman*, Puu Kaala, near summit, Waianaeuka, alt 3,900 ft , wet stream bank, Nov 24, 1929, *H St John 10,072*, Mt Kaala, on moist upper slope by spring, elev 1,100 ± m , April 21, 1929, *E H Bryan Jr 707*, Mt Kaala, Waianaeuka, 4,000 ft elev , Feb 2, 1930, *E Y Hosaka 139*, Schofield trail to Kaala, steep wet slope, elev 3,300 ft , April 24, 1932, *E P Hume 547*, Puu Kaala, 3,600–3,800 ft , Waianaeuka, Jan 8, 1938, *N. H Krauss*, Kaala, eastern slope, at summit near spring, Sept 25, 1938, *O Degener, E Ordonez and O Selling 12,251*

Koolau Range Konahuanui, near summit, Oct 19, 1930, *J R Coleman*, *Puu Konahuanui*, east face, n e of north peak, head of South Fork of Kahanaiki Stream, Kailua, 2,950 ft alt , thicket on steep pali, June 21, 1942, *L Eubank and A D Conger 131* Puu Konahuanui, precipitous, small, hanging valley, east side of Koolau Divide, head of North Fork of Kahanaiki Stream, 2,300 ft alt , Kailua, May 9, 1943, *H St John 20,335*

The localities for this species are discussed in the introduction

Gunnera kaalaensis forms a narrow belt on the eastern side of Mt Kaala It is conspicuous and is collected by most botanists The older collections, as that by Mann and Brigham in 1864–65 were probably made on the old trail that ascended from Waialua The numerous recent collections are apparently all from the station on the trail from Schofield Barracks, above the Firebreak Trail in Waianaeuka The collectors have stated the elevations all the way from 3,200 to 4,000 feet Doubtless all of the collections on this trail were made at the base of the "pali" (precipice), or by the "spring" or stream above it at elevations between 3,500 and 3,700 ft The plant does not seem to occur at the actual summit On the earlier U. S Government topographic map of 1917, the mountain was given the Hawaiian name, Puu Kaala, and an elevation of 4,030 ft The recent one of 1938 calls the peak Mt Kaala, and measures it as 4,025 ft high

The collection from Puu Kaala, St John 10,072, shows on one sheet a young inflorescence which has the petals either entire or sparsely fimbriate This fringing of the petals is not constant and has not been observed in any of the other numerous collections

Krajina (p 50) in separating this as var *kaalaensis* included among the characters that it had the blade shining above, while the blades of his var. *mauiensis* were not shining In this present revision, this character is not substantiated, no diagnostic difference in the shininess of the blade being noted between these two or any others of the Hawaiian species of *Gunnera.*

6 **Gunnera makahaensis** St John, sp nov

(Plate 37, fig b)

Herba gigantea, caule 1.5 m alta 15 cm diametro, potiolis ad 7 dm longis, laminis 20–37 cm longis cordato reniformibus arcte 7–9 lobatis chartaceis molle hirsutis in nerviis vel glabratis infra pallidioribus molle adpressi hirsutis in nerviis reticulatis lobis sinuatis denticulatis mucronatis, pedunculo bracteoso, bracteis 15–20 mm. longis 4–5 mm. latis oblongo spatulatis marginibus membranaceis bifimbriatis, pedunculo 5–7 cm. longo, inflorescentiis 15–60 cm longis anguste lanceoloideis, axi tomentoso, bracteis inferioribus 15–35 mm longis, ramulis spicatis, floribus viridescentibus sepalis 1–1 2 mm longis late deltoideis profunde laceratis, petalis 1 9–2 2 mm longis obovatis cucullatis marginibus erosis vel laceratis saepe acuminatis, antheris 1 6–2 2 mm longis ovalibus, drupis ignotis.

Giant herb, 2 m tall, stem about 1 5 m tall and 15 cm in diameter; stipules not seen, petioles about 7 dm long, somewhat hirsute, soon glabrate, sparsely tuberculate, blades 20–37 cm long, cordate-reniform, shallowly palmately 7–9-lobed, firm chartaceous, above dark green, sparsely soft hirsute on the veins or glabrate, below pale green, appressed soft hirsute on prominent veins and reticulate veinlets, the lobes 1 5–4 cm long, shallowly sinuate semiorbicular, the sinus broad and open U-shaped, the margin minutely salient denticulate and the principal dentations revolute mucronate; inflorescence probably axillary, bracts at base of peduncle 5–6 cm long, oblanceolate, scurfy towards the tip and margin, peduncle when young clothed with numerous imbricate bracts which are 15–20 mm long, 4–5 mm wide, oblong spatulate, firm, glabrous, with a conspicuous broad membranous margin lacerate and ciliate fimbriate, the peduncle 5–7 cm long, inflorescence 15–60 cm long, 6–10 cm in diameter, narrowly lanceoloid, the axis brown tomentose, the principal lower bracts 15–35 mm long, oblong-linear, acute, firm, the conspicuous membranous margin lacerate and ciliate fimbriate, the lateral branches ascending, densely spiciform, tomentose except towards the glabrate tip, flowers perfect, sessile, greenish, ovary depressed globose, calyx lobes 1–1 2 mm. long, broadly deltoid, deeply lacerate, petals 1 9–2 2 mm long, obovate cucullate, the margin erose to lacerate, often acuminate, the 2 anthers 1 6–2 2 mm long, oval, the 2 stigmas 1 5–2 mm long, filiform, densely puberulous; drupes unknown

Type. **Oahu, Puu Kawiwi-Mt. Kaala ridge, Makaha-Waianae Kai, Waianae Mts.,** moist thicket in gulch, above pali [precipice], **3,500 ft. alt.,** March 31, 1935, *H St John 17,581*

Collections studied · Oahu Kaala Range, Makaha V[alley], Feb 12–19, 1909, *C. N. Forbes*, Mt Kaala, Waianae Mts, on wet wooded slope, el 4,000 ft., (specimen brought by other students probably from the Makaha side), Feb. 2, 1930, *E. Y. Hosaka.*

The specimen preserved by Hosaka was given him by other students who pushed ahead and crossed the summit to the Makaha side Hence, his generalized data and elevation of 4,000 feet are not to be considered accurate

It is remarkable that there are two species on Mt Kaala, *G kaalaensis* being abundant on the wet windward slope, 300 to 500 feet below the summit. *G. makahaensis* is infrequent at about the same altitude on the drier leeward slope Actually, the broad, flat summit is well watered and supports a swampy forest with a few boggy openings *Gunnera* has not been found on the summit The locality of this new species is along one of the streams draining from the wet summit down towards the dry Makaha Valley

The islands Kauai, Molokai, and Hawaii each produce a single species. Maui bears two species, one on each of the isolated mountain masses of east Maui and west Maui Oahu has one species in both mountain ranges with a considerable gap between the localities on Puu Konahuanui in the Koolau Range and Mt Kaala in the Waianae Mts It is known only on the eastern slopes of Mt Kaala Yet, on the drier, westward slope we find a second species It is amply distinct from its close neighbor in characters of sepals, petals, anthers, bracts, leaf blade size, lobing, and toothing It is the only Hawaiian species with the marginal teeth of the blade bearing definite revolute cartilaginous mucros It has seldom been collected because of its scarcity and the long difficult ascent to the locality

7 **Gunnera kauaiensis** Rock

(Plate 37, fig a)

Gunnera kauaienis Rock, Occ Pap Bishop Mus 9(5) 3–4, pl 1, 1930, Sept
G Dominii Krajina, Acta Botanica Bohemica 9 50, 52, figs F_1, B_1, I_1, Fl_1, P_1, A_1, 1930.

Giant herb, 1–3 m tall , stem 1–1.3 m tall, 10–15 cm or more in thickness, fleshy, decumbent at base , stipules 4–5 cm long, obovate, erose, pilose towards the margin, membranous, strongly nerved, petioles 3–6 dm to "more than 1 meter" in length, at first brownish tomentose but soon glabrate except at base, purplish, with scattered pustules, blades 0.8–2 m in diameter, suborbicular peltate about ⅓ way from one side, firm chartaceous, above dark green, sparsely hirsute to subglabrate, below pale green, hirsute on the raised reticulate veins and veinlets, the margin palmately 9–11-lobed, the lobes semiorbicular, acute, 5–10 cm long, with a broad U-shaped sinus, the margin coarsely doubly dentate, the teeth 2–4 mm long , inflorescence probably axillary ; basal bracts not seen , peduncle 6–10 or more cm in length, brownish hirsute ; inflorescence 3–6 dm long, ("1 meter or more long," fide Rock), 8–17 cm in diameter, dense, lanceoloid, the axis densely brownish hirsute, at length subglabrate, lower primary bracts 15–18 mm long, oblong-lanceolate to spatulate, glabrous, the margin scarious, the lateral branches ascending, spiciform, hirsute at base, glabrate at tip ; flowers perfect ; ovary depressed globose, calyx lobes 0.3–1 mm long, deltoid, the margin thin, lacerate, petals 1.1–1.3 mm. long, obovate cucullate, the margin ciliate or lacerate, the 2 anthers 1.9–2.1 mm long, oval ; the 2 stigmas 1.5–2 mm long, filiform, densely pubernulous, drupes 3–4 mm in diameter, globose, red to purplish, stone 1 9 mm long, 1.6 mm wide, 1 4 mm thick, oval, somewhat compressed, the apex emarginate, conspicuously 3-angled, the 2 lateral angles equal, acute, the 3rd angle prominent and acute in the upper half, wanting below, the 4th angle undeveloped, the surface stramineous, dull

Type "Kauai, along the stream beds of Kaluiti and Kaihili, just below the summit of Waialeale, elevation 4800 to 5000 feet, September 22, 1909 (fruiting), J F Rock no 5053 Type B P. Bishop Mus" On one or more of the five isotypic sheets are found the numbers 5,050, 5,053, and 5,058 These are apparently individual numbers given by the collector to each sheet Later he selected the number 5,053 to stand for the collection They all bear also the number 129 which perhaps may be a trip number, though it duplicates the one for the collection from Hawaii in the same year Rock's three series of numbers on his collections are not well understood by the botanists of Honolulu

Collections studied, all from Kauai Kahili summit, Aug 1909, *C N Forbes*, Kilohana Outlook above Wainiha, Waimea Drainage Basin, West Side, July 3 to Aug 18, 1917, *C. N Forbes 903 K*, Kilohana lookout, N W end Alakai Swamp, Na Pali Kona forest reserve, wet steep slope, el 4,023 ft, Dec. 27, 1930, *H St John et al, 10,788*, without locality, Oct. 1916, *J F Rock*

Rock (p 3) described the "Panicle terminal" Neither his specimens nor any others of those available in Honolulu show an attached inflorescence All of the other Hawaiian species have their inflorescences developing near the stem tip, but truly axillary, and it seems probable that this one does too. The inflorescence is not a true panicle, rather it has an erect common axis bearing numerous ascending, unbranched spikes

This is the most distinct of the Hawaiian species, differing markedly from all the others It alone has orbicular, peltate blades and drupes that are red to purplish It also differs in the size and structure of the flowers and fruits

As indicated in the introduction, it is still an open question as to which of the two specific names of this species is the earlier *G kauaiensis* Rock was published in September 1930 *G Dominii* Krajina was published in the same year, 1930 (Acta Botanica Bohemica 9 50, 52, figs, 1930) Previous requests for the exact date of publication, sent to Prague have been unanswered Now we acknowledge with thanks the assistance of the librarians of the Gray Herbarium, the British Museum of Natural History, and the Director of the Kew Gardens It is not known whether or not the several articles in volume 9, Acta Botanica Bohemica were issued separately at various dates, or not In any case, volume 9 was commonly distributed as a single bound volume, and the copies were received by the three institutions listed, Gray Herbarium on Oct 25, 1932, Kew on March 6, 1933, and British Museum on April 1, 1936, but these dates of receipt are so late as to be of no help Krajina lists as *G petaloidea* var *mauiensis* his own specimen collected on Maui on April 15, 1930 His manuscript must have been written later than April, and in all probability after he returned to Prague From this it can be deduced only that his paper was not published early in 1930 The first paper in vol. 9 was by the editor, Karel Domin, "A new species of *Psittacanthus* from Dominica," which paper was not listed in the Botanisches Centralblatt until July 6, 1933. The succeeding volume 10 of Acta Botanica Bohemica contained a chronological bibliography of Dr Karel Domin's publications Two of them were published in volume 9, and they are listed in the bibliography as appearing in 1930 In one of these papers, page 256, Domin cites a plant specimen collected on Sept 20, 1930, which would imply that his paper was printed late in the year 1930 Volume 12 (1934) of the Prague journal Preslia is devoted almost entirely to bibliographic notes, and it lists Krajina's *Gunnera* paper as published in 1930, stating only the year It is not known that this vol 9 was issued only in complete volume form, and the exact date of Krajina's publication is still unknown Since Rock's publication was dated Sept 1930, it is tentatively accepted as the prior publication

PLATES

PLATE 37

Margin of terminal and one lateral lobe of blade of the Hawaiian species of *Gunnera* a, *G kauaiensis*, b, *G makahaensis*, c, *G kaalaensis*, d, *G petaloïdea*, e, *G molokaiensis*, f, *G Eastwoodae*, g, *mauiensis*

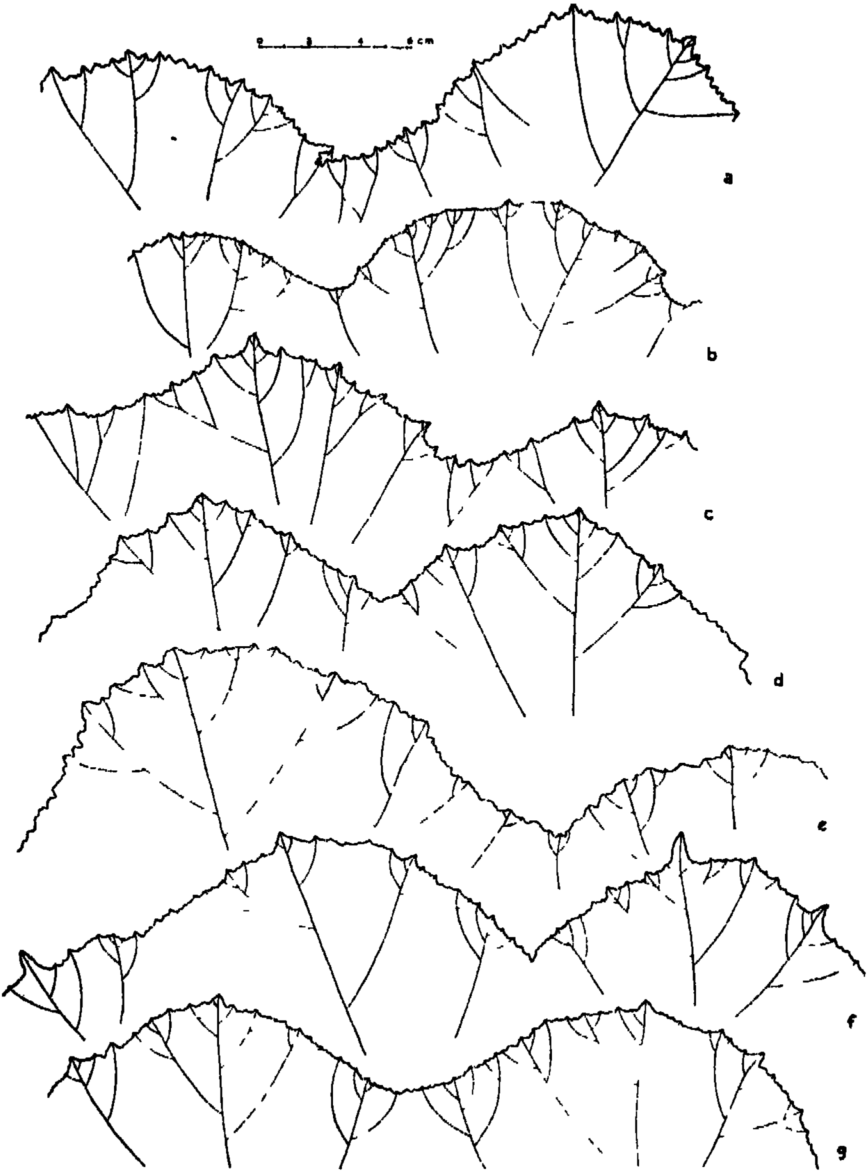

0
2
4
6 cm
a
b
c
d
e
f
g

PLATE 38

Gunnera petaloidea **Gaudichaud, type in Herb Museum d'Histoire Naturelle, Paris.**

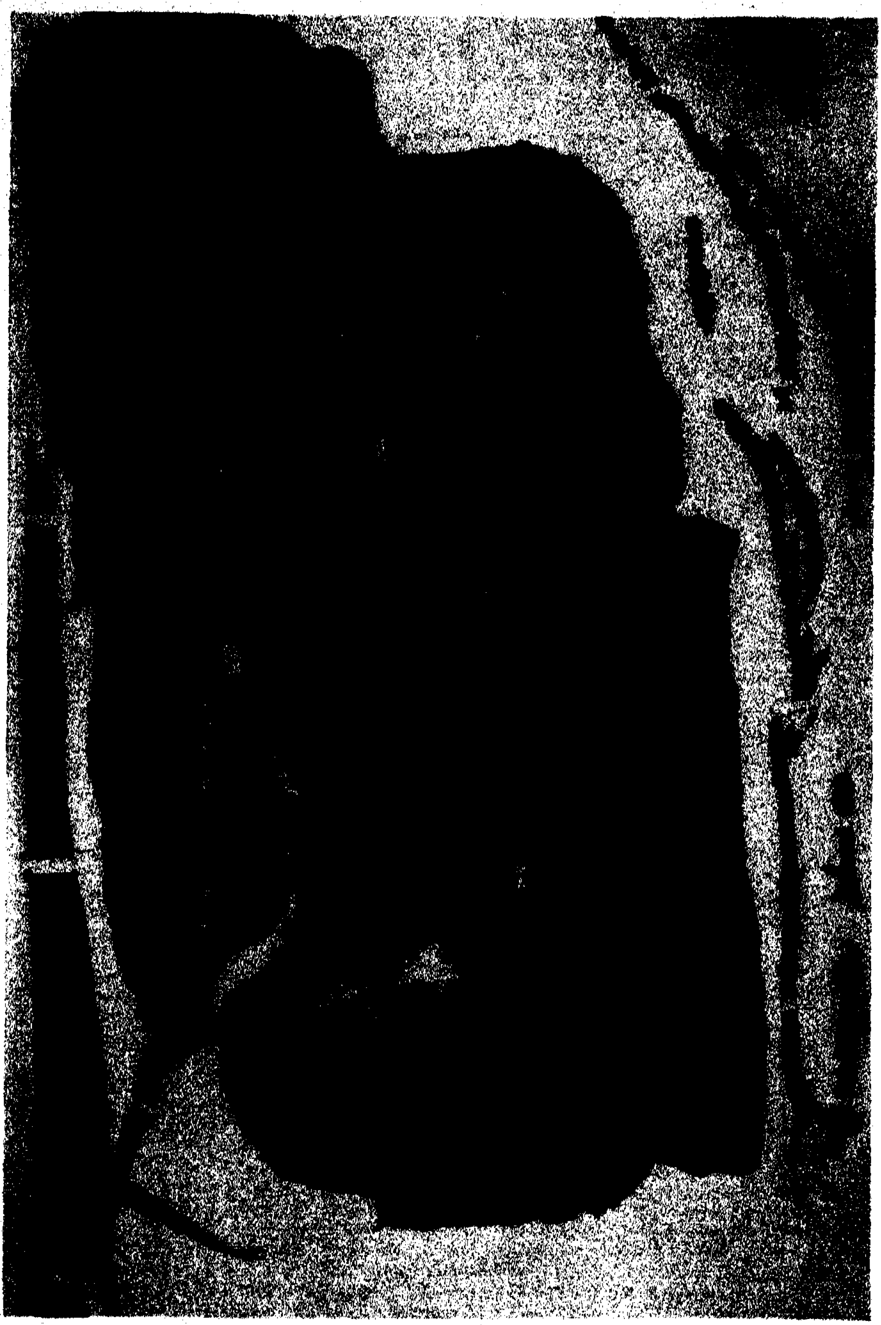


Photo by H. St. John.

PLATE 39

Gunnera petaloïdea Gaud , at head of Kahana Valley, 3,800 ft alt , west Maui, October, 1942

Photo by David T. Fleming.

PLATE 40

Gunnera mauiensis **(Krajina) St John, Kula Pipe Line, bank of Waikamoi Stream, 4,250 ft alt, east Maui, with figure of Royal N Chapman.**

PLATE 41

Gunnera mauiensis (Krajina) St John, Kula Pipe Line, bank of Waikamoi Stream, 4,250 ft alt, east Maui, with figure of Worth Aiken, 1925

Photo by R. J. Baker.

PLATE 42

Gunnera Eastwoodae St John, type specimen, Upper Hamakua Ditch Trail 3,500 ft alt, Waipio, Hawaii, January 1, 1932

Photo by H. St. John.

PLATE 43

Gunnera kaalaensis (Krajina) St John, Mt. Kaala, Waianaeuka, 3,500 ft alt, Oahu, with from left to right, figures (in upper right) of H Pope and W. B Storey

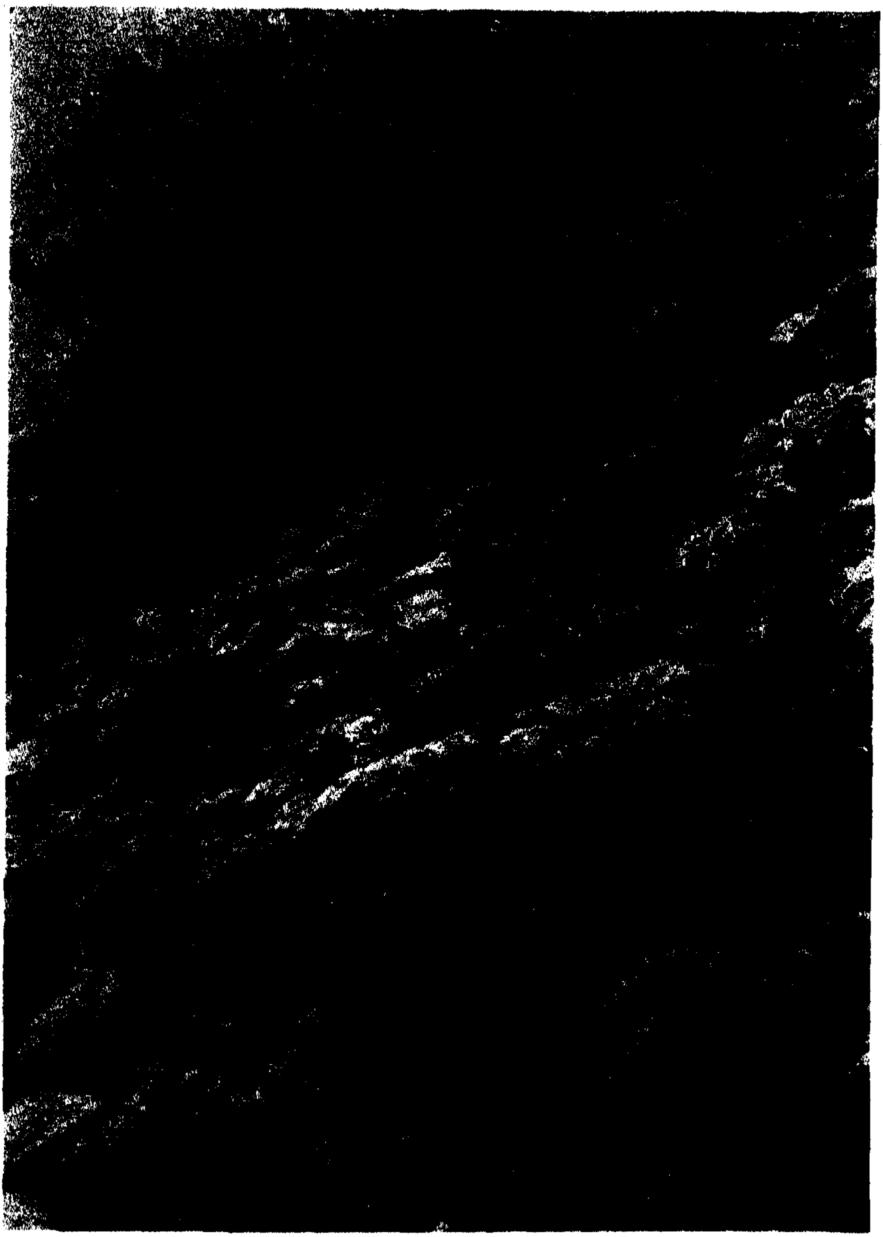


Photo by Willis T. Pope.

PLATE 44

Gunnera kaalaensis (Krajina) St. John, Mt Kaala, Waiana euka, 3,500 ft alt, Oahu, with, from left to right, figures (in foreground) of H Pope and W B Storey

Photo by Willis T. Pope.

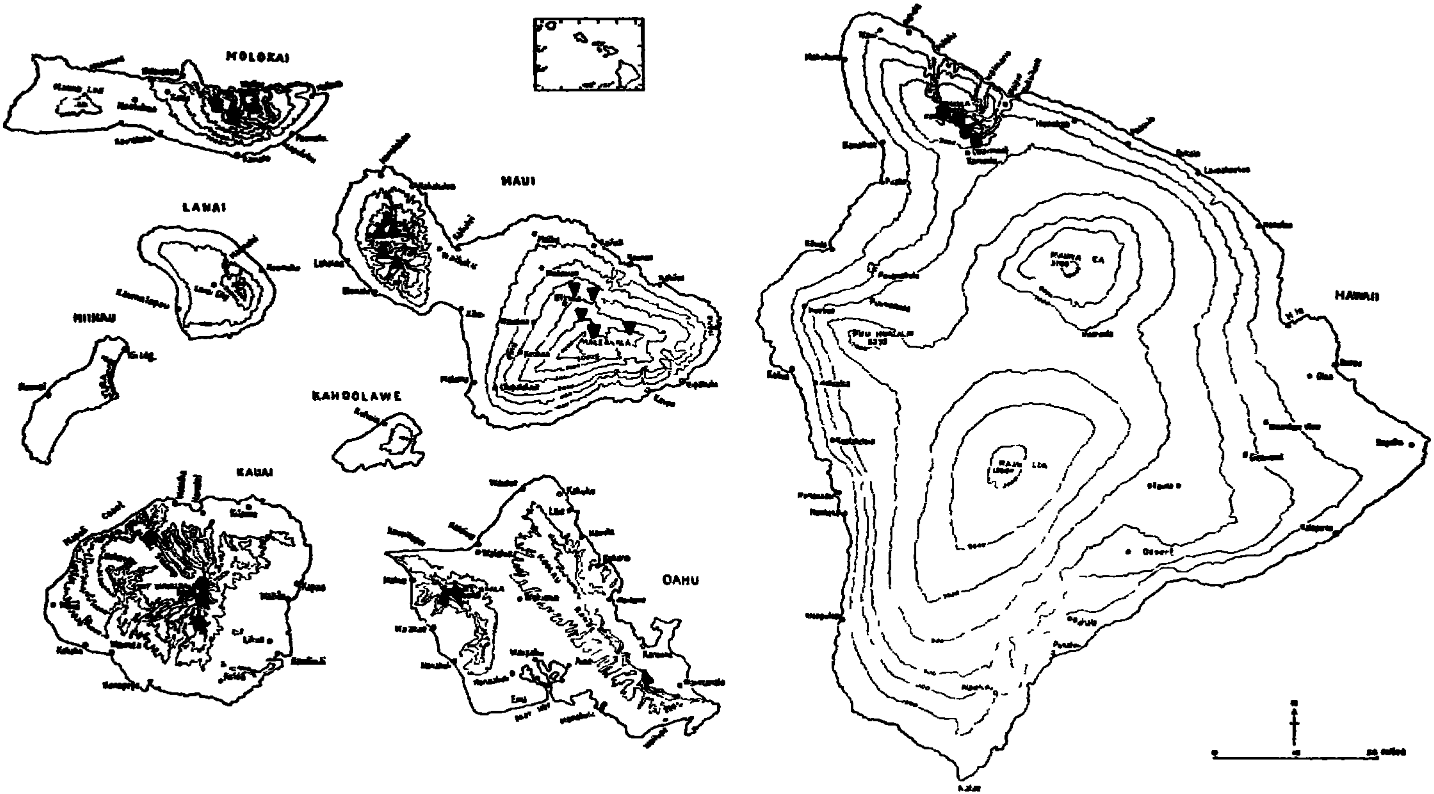
PLATE 45

Gunnera kaalaensis **(Krajina) St John, Mt Kaala, Waianaeuka, 3,500 ft alt, Oahu.**

Photo by Willis T. Pope.

PLATE 46

Distribution of *Gunnera* in the Hawaiian Islands
Square *Gunnera molokaiensis*, Erect Triangle *G petaloidea*, Inverted Triangle *G mauiensis*, Shield *G Eastwoodae*, Circle *G kauaiensis*, J *G makahaensis*, L *G kaalaensis*


MOLOKAI
LANAI
NIIHAU
MAUI
KAHOOLAWE
KAUAI
OAHU
HAWAII
MAUNA KEA
MAUNA LOA
HALEAKALA

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ALICE EASTWOOD SEMI-CENTENNIAL PUBLICATIONS*

No. 17

A REVISION OF THE ARTEMISIA VULGARIS COMPLEX IN NORTH AMERICA†

BY
DAVID D KECK
Carnegie Institution of Washington
Division of Plant Biology
Stanford University, California

THE NORTH AMERICAN ALLIES of *Artemisia vulgaris* L, an Old World species, form a polyploid complex of great diversity, extending from Alaska to Guatemala, and from Hudson Bay and the Mississippi Valley to the Pacific The center of this diversity lies in the western United States The extent of the problem posed to the systematist by this group of plants is at once apparent by referring to the last two complete treatments of these species Hall and Clements (1923) included under *Artemisia vulgaris* L, with fifteen subspecies, all the American forms which, but fifteen years previously, had been treated as fifty-four distinct species by Rydberg (1916)

These authors were alike in using comparative morphology as the principal tool in their taxonomic work, but their species concepts were at different poles from each other Rydberg had come to believe that any striking morphological form deserved a name, and that this should be a specific name, since he could see no advantage in using trinomials The significance of geographical range was rarely considered Rydberg's species often represent morphologically well-marked forms, but all too frequently they are found to be thoroughly linked with others by intermediates, or to be unique variants, or to have no natural range of their own Often his species are based on one morphological character, which is soon found to occur sporadically here and there

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† Received for publication Feb. 6, 1943

over a large area in which other characters in the same plants show trends of variation in other directions These limitations in Rydberg's species concept make his entities artificial rather than natural

In their monumental monograph, Hall and Clements, at the other extreme, offered the most conservative species concept that could be defended on morphological grounds The result was the telescoping of Rydberg's fifty-four species of this complex into one species, as mentioned above Later evaluation of the same materials by other workers has shown that the fundamental units of Hall and Clements were carefully established Other workers have upheld the majority of their basic units but have often treated their subspecies as species in order to conform with more widely accepted taxonomic practice Hall and Clements' work is therefore sound from the morphological viewpoint, but the addition of one significant new criterion, chromosome number, has now made it possible to see a little more clearly the limits of the species in this group.

The present paper takes the consequences of this discovery and presents a study of many new collections that were not available to Hall and Clements It also utilizes genetical, garden, and field studies as background data for the herbarium studies Several members of this complex were grown in the varied environment experiments conducted by the Carnegie Institution of Washington along a transect across central California, and some cytological and genetical work was done on them The results of these experimental studies have been reported by Clausen, Keck, and Hiesey (1940a) Additional forms have since become available for cytological study The herbarium investigation was made at the time when the results from the transplant experiments were being prepared for publication, because the cytogenetic findings showed the need for a revised systematic treatment

The investigations of Clausen, Keck, and Hiesey (1940a and b) showed that several ecospecies must be recognized in this polyploid complex On the other hand, from a limited amount of evidence these authors suggested the possibility that, to use the biosystematic term, only one cenospecies was involved in the whole subsection *Vulgares* of *Artemisia,* i e, that at least a limited amount of interbreeding and gene exchange could still take place among its members.

The morphological variation of the plants composing this complex is very great, making the delimitations of natural groups a difficult problem. The prominent characters of taxonomic use include size of parts such as leaves and heads, shape of leaves, and quality and quantity of the pubescence Most of these are subject to environmental modification and must be interpreted with that in mind. Vegetative propagation by means of rhizomes is well developed in most of the species, and notable variations may be perpetuated for long periods in this manner Under adverse climatic conditions, as in the far north and at alpine heights, it may be only the exceptional year in which these plants are able to propagate themselves sexually, although they are strongly established in these localities (Hultén, 1937, p. 327, Clausen, Keck, and Hiesey, 1940a, p. 336) Furthermore, single characters, which some authors have utilized in the past to differentiate "species" in this group, have been found very undependable for this purpose It is only when a group of characters is found correlated to each other within a given territory that the existence of a natural systematic unit can be surmised Even then the systematist must reconcile himself to having a residue of specimens that he must arbitrarily include or exclude from a given unit of lower order, because natural crossings between such units produce recombinations that do not fit his key

When historical precedent has entrenched a name in the botanical manuals, only a thorough revision of the group can properly appraise it For example, Thomas Nuttall in 1818 proposed four species in this group One, based on a specimen from near St Louis, with leaves lightly tomentose on the upper surface and densely tomentose beneath, he named *A ludoviciana* A second, based on specimens from the Wisconsin area, with leaves white-tomentose on both sides, he named *A gnaphalodes* These two species have been maintained in the majority of botanical works down to the present, yet this writer agrees with Asa Gray that there is no warrant for separating these variations even in a subspecific category The only characters that have been proposed for distinguishing them prove to be completely scattered in distribution, with every indication of complete interbreeding between the forms

This revision employs orthodox taxonomy rather than experimental taxonomy (biosystematics), because the experimental evidence has been very incomplete Consequently, it has not been possible to determine the exact genetic-ecologic boundaries of the various units, and thus to apply more than superficially the concept of species set down by Clausen, Keck, and Hiesey (1939a) Consequently, most reliance has necessarily been placed upon comparative morphology coupled with distribution, and all of the available cytological information has been used In order to recognize units as comparable as possible with those determined by experiment, the geographic-ecologic principle has been followed in developing this species concept That is, an attempt has been made to find key morphological distinctions that mark groups limited by natural environmental barriers, whether these barriers be geographical or ecological From the kind and amount of intergradation observed between the natural units thus set off, the systematic category of the units has been determined

Under the biosystematic concept of species at least partial genetic barriers exist between species A difference in chromosome number is a genetic barrier to free intercrossing, and so it in itself may be taken as evidence that distinct species are involved, provided that morphological differences have had time to follow the genetic break. In the present group of species the differences in chromosome number coincide with major morphological breaks in each instance examined.

In the *vulgaris* complex the morphological breaks between species are only moderately distinct This prompted Hall and Clements to keep all its units in one species As compared with almost all the other species of the section *Abrotanum* to which this group belongs, the specific differences in the subsection *Vulgares* are not morphologically large A gauge for species is set, however, by the chromosome data where they are known With these as a basis, the other species have been delimited as regional groups of comparable order, showing relatively little intergradation

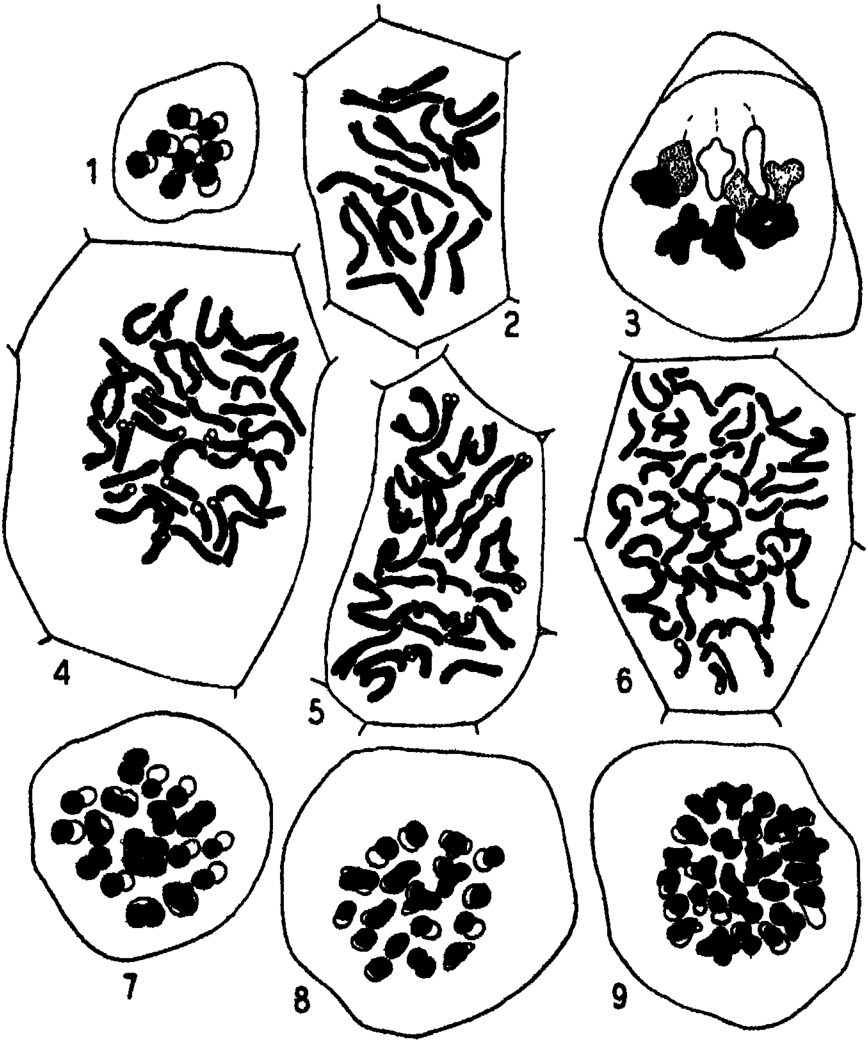
Regional groups that differ from each other in morphology and distribution, but that intergrade completely where their ranges overlap, appear to lack genetic barriers Such units are treated as subspecies, and all of these are geographical Because of the extensive morphological variation in these plants, requiring broad subspecies, it is likely that the larger subspecies contain more than one ecotype.

Morphological variants that from herbarium evidence do not appear to have either geographic-ecologic correlation or genetic barriers separating them are not named These often striking variants are the *formae* of many taxonomists, but such uncorrelated forms cannot be considered of phylogenetic significance

Cytological and Genetical Evidence The chromosome numbers of 37 plants from eight American systematic units, including seven species, have thus far been determined in addition to the European *A vulgaris* These chromosome numbers have been reported previously by Clausen, Keck, and Hiesey (1939b, 1940a and b), but several additional collections are reported in this paper for the first time The enumeration of the collections that have been counted follows the citation of specimens of the unit concerned

The European *A vulgaris* is a diploid species, with $n = 8$ chromosomes In contrast, all the American forms of the *Vulgares* that have thus far been investigated follow a 9 series of chromosome numbers This cytological difference alone is sufficient to keep all the American forms out of the Old World *vulgaris* *Artemisia Carruthii* and *A Suksdorfii* are diploid, with $n = 9$, *A. serrata, A longifolia,* and *A ludoviciana* sspp *typica* and *incompta* are tetraploid, with $n = 18$, and *A Douglasiana* and *A Tilesii* ssp *unalaschcensis* are hexaploid, with $n = 27$ Chromosomes of these forms are illustrated in figures 1–9. The two American diploid species thus far known, *A Carruthii* and *A. Suksdorfii*, have larger chromosomes than any of the other forms including the diploid *A vulgaris,* with the chromosomes of *A Suksdorfii* the largest of all

The little breeding work that has been done with these plants has for the most part been reported (Clausen, Keck, and Hiesey, 1940a) This report covered selfings of *A. Douglasiana* from Santa Barbara, and of *A. ludoviciana typica* from Manitou, Colorado, and also two pentaploid hybrids that were obtained when these two races were crossed. An additional cross has been attempted between *A ludoviciana typica* from Leevining, California, and *A Suksdorfii* from Trinidad, California, in the hope that *A Douglasiana*



Figures 1–9 Heterotypic metaphases of meiosis in pollen mother cells and somatic metaphases in roots Fig 1 *Artemisia vulgaris*, Skåne, Sweden, 8_{II} Fig 2 *A Carruthi*, Springer, New Mexico, $2n = 18$ Fig 3 *A Suksdorfii*, White Horse, Washington, 9_{II} Fig 4. *A. serrata*, St. Paul, Minnesota, $2n = 36$. Fig 5 *A longifolia*, Billings County, North Dakota, $2n = 36$. Fig 6. *A Douglasiana*, Medford, Oregon, $2n = 56$ Fig 7 *A ludoviciana typica*, Manitou, Colorado, $16_{II} + 1_{IV}$, Fig 8 *A ludoviciana incompta*, Yosemite Creek, California, 18_{II} Fig 9 *A. Tilesii unalaschcensis*, Unalaska, Aleutian Islands, 27_{II} Enlargement for all figures *ca* × 2400

might be synthesized through amphidiploidy, but it did not have a fair chance, because the races tested differed too much in time of flowering The supposed amphidiploid origin of *A. Douglasiana* is discussed in more detail on page 459

The Subsection in Perspective The members of the *vulgaris* complex are widely distributed across the North American continent There are two diploid species of radically different appearance Along the Pacific shores of the United States from the Canadian boundary to northern California grows *Artemisia Suksdorfii,* a stout, large-leaved herb in clumps often more than a meter high and half again as broad On the more arid plains and plateaus from western Kansas and Colorado to Chihuahua is *A Carruthii,* a low gray clump with tiny fascicled leaves, in marked contrast with the preceding diploid

Through the midlands of the continent there is a group of tetraploids perplexing in their variation On the periphery it is relatively simple to disjoin *A serrata* and *A. longifolia* from the mass, the former in the upper Mississippi Valley, and the latter spreading somewhat westward from the prairies and badlands of the Dakotas. The remainder goes through an impressive amount of variation across the western half of the United States and down the length of Mexico, sometimes in accord with the climatic zone occupied, and again in seeming contradiction to the environment From the lowlands and plains this distribution may be traced up through the timbered slopes to the alpine summits, and from the regions of abundant rainfall out across the arid desert ranges No lines of demarcation of even relative sharpness are at first apparent, for even the regional facies of the assemblage show rather frequent intergradation As a consequence, this tetraploid diversity is gathered under one specific name, *A ludoviciana* The regional races of individual caste within it are demarked as subspecies—seven in all Where the sampling has been dense, as in Colorado, the abundance of examples makes the broad gamut of variation appear but the more confusing, however, from this it becomes apparent that the number of specific barriers to interbreeding in this assemblage is strictly limited—that the variation is intra-, rather than inter-specific In Mexico, on the other hand, additional sampling may well uncover regional subspecies too poorly discerned for recognition at present The potential variation is certainly there The increased sampling available to us now has resulted in the recognition of the validity of *sulcata* and *albula* as subspecies of *ludoviciana* from the arid Southwest, while the same abundance of material has failed to develop any substantial basis for separating *gnaphalodes* from *ludoviciana,* or *Wrightii* from *Carruthii,* all of these results running at variance with rather recent conclusions drawn from less material

The two known hexaploids are *A. Douglasiana,* from a Pacific Coast region between *A Suksdorfii* and *A ludoviciana,* respectively its diploid and tetraploid presumed progenitors, its individuals becoming the largest in all the complex; and *A. Tilesii,* a coarse herb with two subspecies distributed from the Pacific Northwest to the Arctic Ocean and to the western shore of Hudson Bay, but obviously coming to our continent from Asia, for the trail is clear both across Bering Strait and the Aleutians to Kamchatka, and westward to European Arctic Russia. Its near-relatives remained in the Old World.

The chromosome numbers of *A. Michauxiana* and *A. Lindleyana* are not known as yet, and that information is desirable for the completion of the picture The alpine *A. Michauxiana* is a quite well-marked entity with its small, much dissected and finely cut leaves, its large heads and low stature, and its near-restriction to the northern Rockies *Artemisia Lindleyana* is a suffrutescent plant—a distinction from the usual herbaceous forms—with a distinctive subracemose inflorescence but somewhat variable leaves. Its distribution is a natural one along the low elevation watercourses of the Columbia River system

The least well-known member of the complex is *A. Prescottiana,* an anomalous species of airy aspect due to its long filiform divided leaves, sparse raceme, and very slender branching stem The root is gone from the only specimen I have studied, but it might even have been annual David Douglas collected it six score years ago on the Quick Sand River, near The Dalles, but it seems to have escaped recollection, and it appears to be uncertain today even as to along which stream Douglas found it.

Other conclusions on the derivations of the various systematic units that can be gathered from the several lines of evidence available are presented in the discussion following the systematic treatment (pp 465–467)

Methods, Materials, and Acknowledgments

From the early stages of the investigation it was apparent that a study of this complex in any one herbarium would be very inadequate because of the great variability found in nature and the broad geographic distribution, and that it would be essential to bring together an abundance of herbarium material for comparison Consequently, the material from twelve herbaria was assembled for simultaneous comparison at our central laboratory at Stanford In the case of the more widely distributed collections, this made possible the comparison of all the material from one locality at one time On account of the variation within one habitat, this is a much safer method than comparing the materials in one herbarium at a time

So many herbarium specimens have been studied that their citation in entirety becomes impractical Distribution maps therefore indicate wherever possible the approximate location of each collection, leaving for the citation lists only a limited number of collections These have been chosen because they are reasonably representative and widely distributed to herbaria, or because they mark the range or otherwise have special interest. Citation is more complete for those groups that are rare, or that were previously understood inadequately The complete documentation is to be found in those herbaria in which material was studied and annotated In so far as possible citation is by counties in a north to south and east to west geographical sequence, the county name is followed by a colon

The descriptions are cross-comparable and made as brief as permissible if they are to have a utilitarian value in a group marked by so great diversity The distribution and ecological data are gathered from the herbarium specimens and from some personal field knowledge of the group.

During the taxonomic investigation collections were studied and annotated in the following herbaria The abbreviations are those employed in the citation of specimens In those herbaria marked with an asterisk, only selected groups were examined·

C—University of California, Berkeley
CAS—California Academy of Sciences, San Francisco
CI—Carnegie Institution of Washington, Stanford University, Calif
*Minn—University of Minnesota, Minneapolis.
NY—New York Botanical Garden, New York.
Ph—Academy of Natural Sciences of Philadelphia
Po—Pomona College, Claremont, Calif.
RM—Rocky Mountain Herbarium, University of Wyoming, Laramie
SU—Dudley Herbarium, Stanford University, Calif.
US—United States National Herbarium, Smithsonian Institution, Washington, D C
*UW—University of Washington, Seattle.
Veg—Vegetation Type Map Herbarium of U S Forest Service, University of California, Berkeley.

To the curators of these herbaria grateful acknowledment is made for the privilege of study generously afforded and for other help given I am indebted to the late Sir Arthur W Hill, Director of the Royal Botanic Gardens at Kew, for the loan of a few types and pertinent specimens from that institution Particular thanks are due my colleague, Dr Jens Clausen, for critical aid in making taxonomic and cytologic judgments To him also, together with my colleague, Dr W. M Hiesey, I am grateful for a critical reading of the manuscript.

Systematic Treatment

The great diversity of this group of plants has been mentioned One of the most variable organs, which at the same time furnishes key characters of importance, is the leaf In figure 10 some of this variation is shown in order to enable the reader to visualize the type of leaf-cut which words often inadequately describe One is not to assume that this illustration encompasses by any means the entire range of variation that is to be encountered in these systematic units, but these drawings are intended to supplement the key

Key to the Systematic Units

A Divisions of lower leaves again lobed or cleft, 5–15 mm. wide, directed forward, green and essentially glabrous above Old World, eastern North America . . . . . . 1 *A vulgaris*

AA. Divisions of lower leaves entire, or if lobed, the divisions less than 5 mm. wide, spreading, or leaves themselves entire.

  B At least some of the leaves bipinnately parted with salient segments again toothed Northern Rocky Mts. . . . . . . 2 *A Michauxiana*

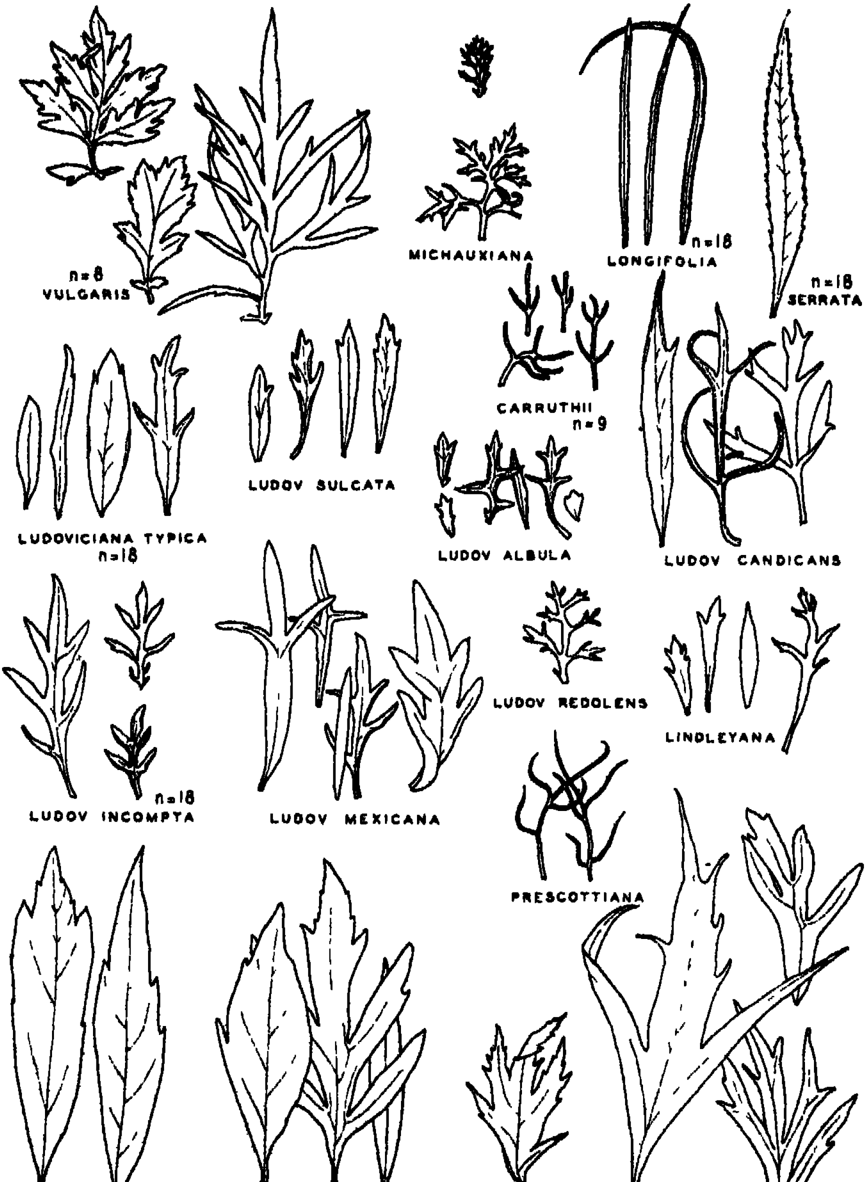


Figure 10 Typical leaf outlines in *Artemisia* subsection *Vulgares* × ⅜.

BB Leaves entire to bipinnatifid with entire lobes.

C Leaves linear to linear-lanceolate, entire, or rarely divided into few usually caudate lobes, often caudate and revolute margined, the tomentum on the upper surface usually deciduous, 3–12 cm long, involucre 4–5 mm high North Dakota to central Wyoming 3 *A longifolia*

CC Leaves not as above, or if slender and entire the involucre shorter

D Leaves finely and evenly serrate, strongly discolored, plant 1–2 5 m tall, heads only 2 mm wide Upper Mississippi Valley 4 *A serrata*

DD Leaves not finely and evenly serrate.

E Leaves fascicled, 1–3 cm long only, divided into divaricate linear filiform lobes 0 5–1 mm wide, panicle narrow, spike like, herbage mostly gray tomentose (leaves sometimes green on upper surface), the heads tomentulose and ± shining Kansas and Arizona to northern Mexico 5. *A Carruthii*

EE Leaves not fascicled, or if fascicled their divisions more more than 2 mm wide or bright green

F Involucre as high as or higher than wide (except in *A ludoviciana candicans*, but in that the leaves not prominently discolored)

G Principal leaves narrow, 1 cm or less wide exclusive of lobes when present, tomentose on both sides or green above, stems rarely more than 1 m tall

H Herbaceous to base 6 *A ludoviciana*

I Principal leaves entire or merely lobed

J Leaves 3–10 cm long, the margin not revolute

K Panicle usually compact, elongated, not leafy, leaves not thin, usually white-tomentose on both sides, rarely bright green on upper surface, involucre 3–4 mm high Ontario and Mississippi Valley to Washington and California 6a *A ludoviciana* ssp *typica*

KK Panicle open, leafy (sometimes contracted), leaves thin, usually bright green above, white tomentose beneath, involucre 2 5–3 mm high Arizona to Chihuahua 6b *A. ludoviciana* ssp *sulcata*

JJ. Leaves mostly 1–2 cm long, lanceolate, thickish, usually white-tomentose on both sides, the margin often narrowly rev

olute, panicle open, the heads pendant in slender ± leafy racemes Southwestern U S and northern Mexico
6c *A ludoviciana* ssp *albula*

II Principal leaves ± parted or divided.

L Involucre 4–5 mm high, 4–7 mm. wide, leaves white tomentose on both sides, plane Western Montana to northern Utah and California 6d *A ludoviciana* ssp *candicans*

LL Involucre 2 5–3 5 mm high, 2–3 5 mm wide, leaves usually green on upper surface (sometimes tomentose on both sides in *incompta*)

M Panicle spike like or racemose, disk florets 15–45 Montane, Montana to Utah and California
6e *A ludoviciana* ssp *incompta*

MM Panicle broader, branching, leafy, disk florets 6–18

N Lower leaves 5–10 cm long, pinnately or ternately divided, the lobes entire, strongly discolored Southwestern U S to southern Mexico
6f *A ludoviciana* ssp *mexicana*

NN Lower leaves 2–5 cm long, bipinnately dissected, green and ± glandular, or moderately tomentose on under surface S W Texas to S E Arizona and Durango
6g *A ludoviciana* ssp. *redolens*

HH Suffrutescent with woody base, leaves narrow, entire to serrate dentate apically, rarely more deeply lobed, panicle narrow, spike like or racemose Banks of Columbia River and tributaries 7 *A Lindleyana*

GG Principal leaves broader, 1–5 cm wide exclusive of lobes when present, frequently entire, lobes if present few, short, entire, discolored, stems frequently more than 1 m tall.

O Involucre terete or narrow ovoid, less than 2 mm. wide, yellow green and shining, ray-florets 3–7, disk-florets 2–8, leaves green above, silvery tomentose beneath. Immediate Pacific Coast and Puget Sound region 8 *A. Suksdorfii*

OO. Involucre campanulate, 2–3 mm. wide, ± tomentose, ray-florets 6–10, disk florets 10–25, leaves less strikingly discolored Western Washington to northern Baja California 9 *A Douglasiana*

FF Involucre wider than high

P Stem branching at base, herbage very sparingly arachnoid pilose, somewhat more densely so (but not tomentose) on under surface of leaves, leaves pinnatifid with 3–7 filiform divisions less than 1 mm wide, inflorescence racemose Columbia River 10 *A Prescottiana*

PP Stem unbranched at base, leaves tomentose on under surface, strongly discolored, deeply incised, the divisions wider, inflorescence a spike like panicle 11 *A Tilesii*

Q Inflorescence overtopped by the leaves, involucre 4–5 mm high, 6–9 mm wide, heads 30–125 flowered Siberia to Hudson Bay 11a *A Tilesii* ssp *typica*

QQ Inflorescence well exceeding the leaves, involucre 3–5 mm high, 4–8 mm wide, heads 30–55 flowered Northern Japan, Kamchatka, Alaska to Pacific Northwest 11b *A Tilesii* ssp *unalaschcensis*

1 **Artemisia vulgaris** L , Sp Pl 848, 1753

Figures 1 and 10

Type statement "Habitat in Europae cultis, ruderatis "

Stems 5 to 15 dm tall, slender to moderately stout, herbaceous to base, commonly unbranched; lower leaves obovate to deltoid-ovate in outline, deeply incised into 3–7 lance-ovate to narrowly lanceolate principal divisions, which are for the most part again irregularly and sharply toothed or lobed, the lobes and teeth all directed forward, 5–12 cm long, often nearly as wide, green and glabrous or nearly so above, densely white-tomentose beneath, the margin obscurely revolute, inflorescence an ample leafy panicle with ascending branches crowded with subsessile heads, 3–15 cm broad; heads medium-sized, erect or nodding; involucre campanulate, 3–4 mm high, 2.5–3.5 mm wide, moderately tomentose, with 9–13 bracts; ray-florets 6–9, disk-florets 13–20

Common throughout Europe and eastward to Siberia; probably adventive in North America, but in places appearing indigenous, occurring irregularly from Newfoundland to Manitoba and Alabama

Material of this species was examined in only three herbaria In addition to the localities cited by Hall and Clements (1923), collections should be reported from the states of New Hampshire, Vermont, Massachusetts, and North Carolina

The chromosomes were counted in meiosis of plants grown from seed collected in Skåne, southern Sweden, and kindly sent by Dr Gote Turesson

2 **Artemisia Michauxiana** Bess in Hook, Fl Bor Amer 1 324, 1833

Figures 10 and 11

Type statement "Rocky Mountains *Douglas* Columbia *Douglas, in Herb Lindl*" The type is in the Lindley Herbarium, according to a note attached to a sheet in the Bentham Herbarium at Kew, which is said to correspond exactly with the type (*fide* R A Rolfe) This Kew sheet has been labeled in Douglas' hand, "In fissures of dry rocks near the Kettle Falls and sources of the Columbia 1826" A piece of this sheet was removed and sent to New York, where it has been labeled as part of the type The first collection cited doubtless came from the Rocky Mountains of Canada, the second may have come from the state of Washington

Artemisia discolor Dougl ex Bess, Bull Soc Nat Mosc 9 46, 1836 The type has been studied on loan from Kew It was collected "on rocky situations near Spokane and the Kettle Falls," by David Douglas It is a somewhat coarser plant than the type of *A Michauxiana*, which came from a higher elevation, but the two can scarcely be separated morphologically Its inflorescence is considerably more open paniculate than that of *Michauxiana*, but this character proves to be variable and lacking in geographic significance in this region as is also the vesture of the herbage

A graveolens Rydb, Bull Torr Club 24 296, 1897 Leaves greener than in the type of *Michauxiana*, but much dissected and to be classed here rather than in *incompta* Type locality Yogo Baldy, Little Belt Mts, Montana

A subglabra A Nels, Bull Torr Club 27·36, Jan 24, 1900 The same form as *A graveolens* Type locality: stony banks of Yellowstone River, near Yancey's, Yellowstone Park, "no. 5748"

A tenuis Rydb, Mem N Y Bot Gard 1 431, Feb 15, 1900 A slender, small headed form of *graveolens*, i e, the green form of the species Type locality Emigrant Gulch Park Co, Montana

A vulgaris ssp *discolor* Hall et Clem, Carn Inst Wash Publ 326 74, 1923

A. vulgaris var *discolor* Jeps., Man Fl Pl. Calif 1141, 1925

A. vulgaris ssp *Michauxiana* St John, Res. Stud St Coll Wash 1 106, 1929.

A. vulgaris ssp. *Michauxiana* var. *typica* St John, *ibid*

A. discolor var *glandulifera* Hend, Rhodora 32 27, 1930 Leaves not tomentose beneath but glandular Type locality eastern base of Steins Mts, Harney Co, Oregon

A vulgaris var *glandulifera* Peck, Man Higher Pls Ore. 766, 1941

Stems 2–4(–7) dm. tall, herbage white-tomentose throughout when young to nearly glabrous and green, leaves short and broad, rather crowded, commonly bipinnately divided with the secondary segments again toothed, the linear lobes widely spreading, acute, rarely elongated, even the uppermost leaves rarely entire, 2–5 cm long, typically bright green above and white-

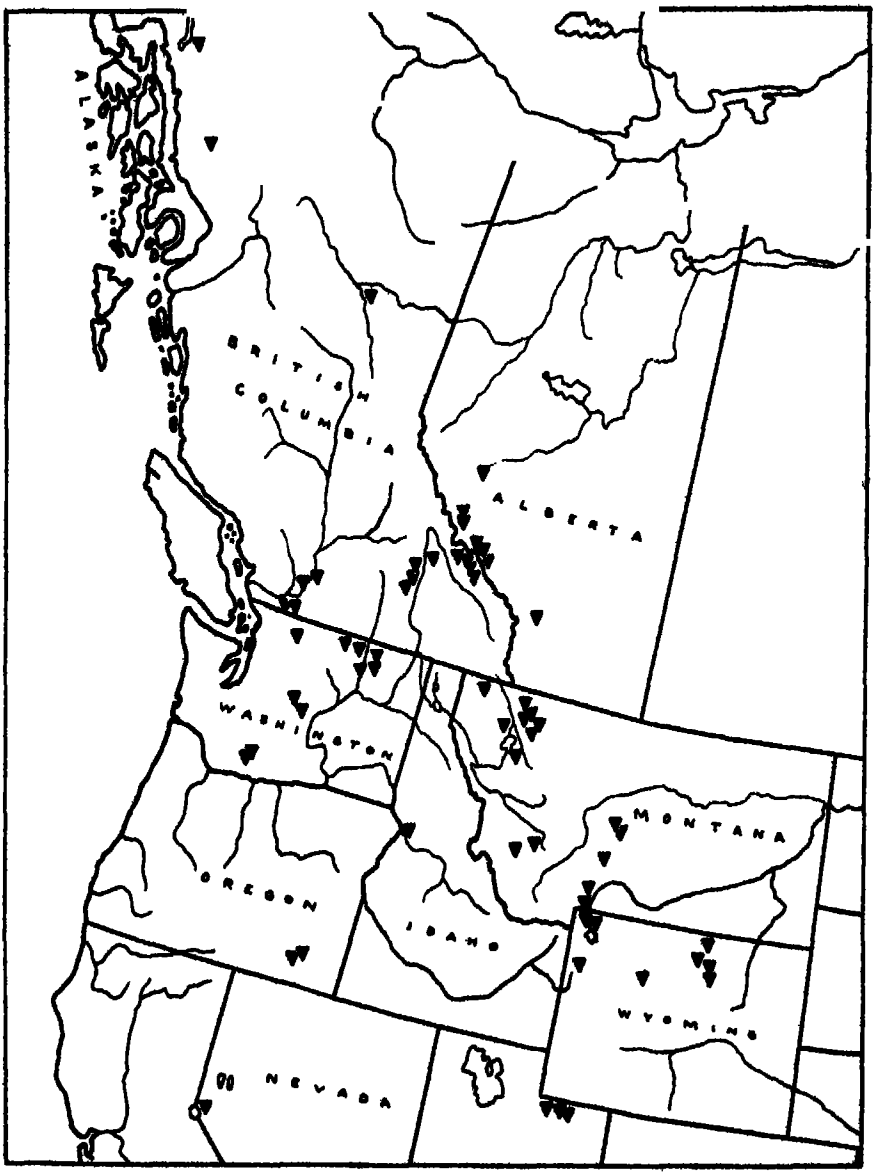


Figure 11 Distribution of *Artemisia Michauxiana.*

tomentose beneath, the margin plane or narrowly revolute, inflorescence a slender racemose or spike-like panicle, occasionally more open, not leafy, heads large, nodding at least at first; involucre hemispheric, 3.5–4 mm high, (2 5–)3 5–5 mm wide, glabrous or sparingly tomentose, with 9–16 bracts, ray-florets 9–12, disk-florets 15–35.

Rocky Mountains of northern Alberta and British Columbia, southward through the mountains to northern Wyoming, northern Idaho, and central Washington, local in Steins Mountains, Oregon, and in Washoe County, Nevada Occurring at elevations of 500 to 2750 meters, and flowering from July to August.

ALBERTA Moberly's on Athabaska, *Schaffer 1612*, Cataract Creek, *Brown 1471*, Pobortan Pass, Lake Louise, Vermilion Mt, Highwood River District, *Brinkman 3209* BRITISH COLUMBIA Mt Atlin, Lake Atlin region, *Swarth 177*, Telegraph Creek, *Walker 1208* Cariboo Mt Selwyn, *Raup and Abbe 3946* Kootenay Mt Whaleback, Yoho Park, *Ulke 334*, Mt Wapta, Kicking Horse River, Carbonate Draw, Selkirk Mts, *Shaw 335*, Goldstream, Revelstoke Yale Fraser Valley, Lake House, Skagit River, *Macoun 76927* New Westminster Yale, Chilliwack Valley MONTANA Glacier Midvale, *Umbach 275*, Many Glacier Flathead Avalanche Lake; Columbia Falls, *Williams 709*, Mission Creek Lincoln Tobacco Mts Judith Basin Yogo Baldy, Aug 24, 1896, 7000 ft, *J H Flodman 881* (NY, type of *A graveolens*), Long Baldy, Little Belt Mts, Aug 19, 1896, 7–8000 ft, *Flodman 881* (US, labeled isotype of *A graveolens*) Deer Lodge Ryans Lake, Mt Haggin Gallatin Mt Bridger Park Emigrant Gulch, 6500 ft, *Rydberg and Bessey 5201* (NY, type of *A tenuis*, isotype, US), Electric Peak WYOMING Sheridan Little Tongue River Canyon, *Williams 3233* Johnson headwaters of Clear Creek and Crazy Woman River (NY) Big Horn Doyle Creek, *Goodding 385* Park Meeteetse Creek, *Griffiths* Yellowstone Park Yellowstone River near Junction Butte, *Nelson 5743* (RM, type of *A subglabra*, isotype, NY) Teton Leigh Lake, *Williams 994* UTAH Summit Blacks Fork, Uinta Mts, Upper Henry's Fork Basin, *Maguire et al 14412, 14586* IDAHO Idaho mouth of Salmon River, *Eastwood 13337* WASHINGTON Okanogan Oroville, Mt Chapaca, *Elmer 589*, Tonasket, Hidden Lakes, Angels Pass, *Thompson 7033* Whatcom Newhalem, *Muenscher 9919* Chelan Nigger Creek, Three Brothers Yakima Mt Adams, *Suksdorf* (C) OREGON Harney Steins Mts, *Cusick 1991*, alpine rivulet near eastern base of Steins Mts, beyond Alvord, *Henderson 8489* (CAS, isotype of *A discolor* var *glandulifera*) NEVADA Washoe head of Galena Creek, 8500 ft, *Heller 10222*

The exact southern limits of this species are difficult to determine on morphological criteria alone Plants from the alpine zone in parts of Nevada, as in the Ruby, White, and Charleston mountains, which appear very similar to the *tenuis* form of *Michauxiana*, are referred in this paper to *A ludoviciana* ssp *incompta*. This is because intergrades seem to connect these forms with very narrow, dark green leaf-segments with forms having the more usual type of *incompta* leaf, and these *Michauxiana*-like forms are fairly well isolated from the other members of *Michauxiana* Their disposition would be more satisfactorily made if cytological data were available

3 **Artemisia longifolia** Nutt, Gen 2 142, 1818

Figures 5, 10, and 12

Type statement "In rocky situations, on the banks of the Missouri, from the confluence of White River to the Mountains?" A single leaf preserved at the Philadelphia Academy, labeled "Artemisia longifolia Missouri" in Nuttall's hand, is doubtless from the type.

A. ludoviciana var *integrifolia* A Nels, First Rep Fl. Wyo 188, 1896 Based upon *A. integrifolia* of Pursh, Fl Amer Sept 2.520, 1814. Not *A integrifolia* L., 1853. Pursh attempted to identify a specimen collected on bluffs of the Missouri River, October 1, 1804, by Lewis, no 53, with the Linnaean species Lewis' specimen at the Philadelphia Academy has been examined.

A natronensis A Nels, Bull. Torr Club 26 485, 1899 A wide leaved form of the species. "Type no is 568, Willow Creek [Wyoming], July 20, 1894, distributed as a variety of A ludoviciana"

A falcata Rydb, N Amer Fl 34 271, 1916 The form with salient linear lobes on the very narrow leaves, but in all other respects typical Found on the southeastern border of the range of this species, the type locality is Fort Pierre, South Dakota

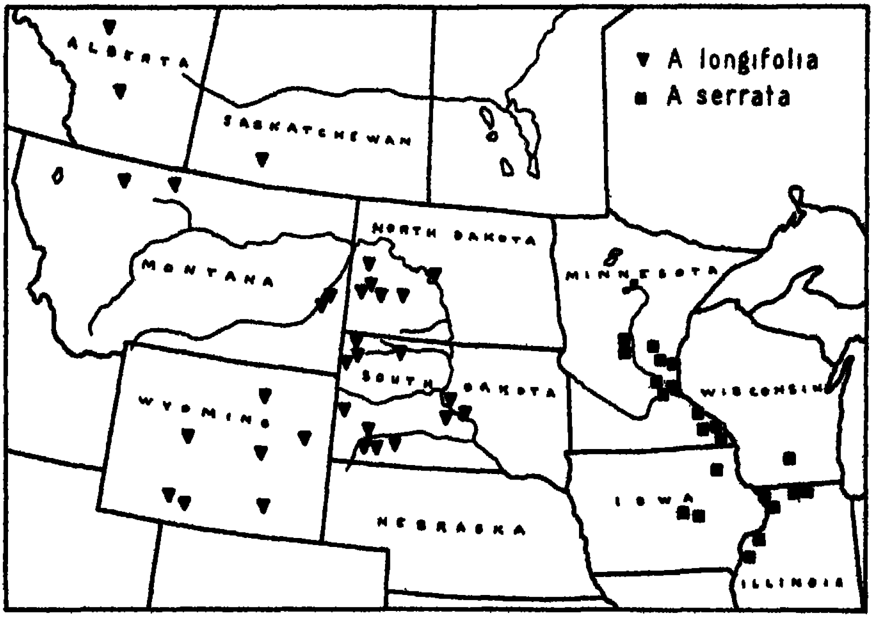


Figure 12 Distribution of *Artemisia longifolia* and *A serrata*

A vulgaris ssp. *longifolia* Hall et Clem, Carn Inst Wash Publ 326 78, 1923
A vulgaris var *longifolia* Peck, Man Higher Pl Ore 767, 1941

Stems 2–8 dm tall, usually rather stout, erect, herbaceous down to the woody caudex, white-tomentose, leaves linear or linear-lanceolate, merely acuminate or, more often, caudate-attenuate, usually entire, sometimes with a few slender teeth or lobes, occasionally the lobes caudate-elongated, 3–12 cm. long, 2–5 (–6) mm wide, those of the inflorescence very narrow and short, all loosely floccose and usually becoming glabrate or green above, densely tomentose beneath, often strongly revolute, inflorescence a strict short panicle, sometimes elongated or rather open, heads mostly erect and peduncled; involucre campanulate or ± turbinate, 4–5 mm. high, 3–4 mm wide, tomentulose to densely tomentose, with 9–17 bracts, ray-florets 8–10; disk-florets 8–26 $n = 18$

Prairies and badlands from Saskatchewan and Alberta to central North and South Dakota, eastern Montana, and southern Wyoming, often in heavy alkaline clays Flowering from July to September

Saskatchewan 1858, *Bourgeau.* Alberta W. of Lacombe, *Moss,* Rosedale, *Moodie 1097.* North Dakota McLean, Morton, McKenzie, Stark, Billings, and Golden Valley counties South Dakota. Evarts, Missouri River, Grand River Stanley· Fort Pierre, Sept 29, 1897, *Griffiths 757* (US, type of *A falcata,* isotype, US, phototypes, C, NY, US) Washabaugh Pine Ridge Reservation Washington Sheep Mt Harding Glaring Fork, Short Pine Hills Lawrence (?) Crow Buttes Pennington Big Bad Lands, *Osterhout 7589.* Montana. Milk River Dawson· Colgate, *Sandberg et al 1011,* Glendive Toole Shelby, *Jones.* (Po) Wyoming Natrona Willow Creek, *Nelson 568* (RM, type of *A natronensis,* isotype, Minn) Johnson Lake DeSmet, *Nelson 8545* Carbon Como Ridge near Medicine Bow, *Osterhout 6290* Converse Badlands, T 38, R 68 Fremont Muskrat Creek, *Goodding 517* Sweetwater Table Rock, Point of Rocks, *Nelson 8148*

Chromosome counts were made in root-tips of four plants from Billings County, North Dakota. The living plants were supplied us through the kindness of Mr E C Moran

4 **Artemisia serrata** Nutt, Gen 2 142, 1818

Figures 4, 10, and 12

Type statement "Near the Prairie du Chien, on the banks of the Mississippi, also on the banks of the Missouri, in open alluvial soils" Upper Louisiana, *Nuttall* (Ph, type)

Artemisia ludoviciana var *serrata* Torr. et Gray, Fl N Amer 2 420, 1843
A vulgaris ssp *serrata* Hall et Clem, Carn Inst Wash Publ 326 79, 1923

Stems 10–25 dm tall, virgate, herbaceous, leaves lanceolate to linear-lanceolate, acuminate, sharply and rather finely serrate from apex well down toward base (rarely subentire), 8–12(–15) cm long, 12–20 mm wide, those of the inflorescence prominent but gradually reduced in size, all dark green and glabrous above, white-tomentose beneath, inflorescence a leafy panicle 5–15 cm broad, heads small, mostly erect, rather crowded, involucre campanulate, 2 3–3 mm high, *ca* 2 mm wide, slightly floccose, with 8–12 bracts, ray-florets 6–11; disk-florets 3–16 $n = 18$

Upper Mississippi Valley, Minnesota to Illinois and Iowa, introduced in New York Flowering from July to September

Illinois Winnebago, Jo Daviess, Rock Island, and Henderson counties Wisconsin Dane *Wibbe* (US) Minnesota Chisago Taylors Falls, *B C Taylor* Isanti *Sandberg* (C) Mille Lacs Milaca, *Sheldon 3878* Stearns Grand Lake, Rockville, *Campbell* Hennepin Fort Snelling, Minnesota River near mouth of Nine Mile Creek. Wabasha Lake City Winona. Wiscoy, *Holzinger,* Winona. Houston Jefferson. Iowa. Fayette *Fink 406* Poweshiek· Grinnell Jasper: Baxter (US)

Chromosome counts were made in root-tips of two plants from St Paul, Minnesota. These plants were supplied through the kindness of Dr C. O. Rosendahl.

5 **Artemisia Carruthii** Wood ex Carruth,
Trans Kans Acad Sci 5 51, 1877.

Figures 2, 10, and 13

Type locality Kansas Type not seen

Artemisia Wrightii Gray, Proc Amer Acad 19 48, 1883 The type collection, *Wright 1879*, made at Santa Rita del Cobre, Grant Co, New Mexico, is scarcely morphologically distinguishable from material from the type region of *Carruthii* The leaves are greener and glabrate on the upper surface in *Wrightii*, tomentose in *Carruthii*, but this feature does not appear in this case to distinguish ecotypes or geographical subspecies. While the *Wrightii* form does not occur to the eastward, it grows together with the typical form at many localities in New Mexico The very broad range of overlapping of the two forms largely obscures any difference in ecological preference that may exist between them, although the incipient stages of ecotype formation may be involved.

A kansana Britt in Britt and Brown, Ill Fl 3 466, 1898 A form identical with *Carruthii* Type locality Lane County, Kansas

A coloradensis Osterh, Bull Torr Club 27 506, 1900 Leaf segments unusually wide, otherwise indistinguishable In the type, from Dale Creek, Larimer Co., Colorado, the segments are less than 1 mm wider than those of *Carruthii* from Kansas, but other collections from the same county are broader and intergrade toward the *Brittonii* form of *A ludoviciana typica*

A Bakeri Greene, Pl Baker 3 31, 1901 Allied to the *Wrightii* form in that the leaves are green on the upper surface, but these are atypically scattered and wide, giving some suggestion of an extremely narrow leaved form of *A ludoviciana mexicana* This does not appear to warrant separation from the more usual forms of *Carruthii*, however, for plants of this appearance are found in the western portion of the range of the species in scattered stations between which more typical forms are found In other words, the variant is of spasmodic occurrence and by no means of uniform appearance The inflorescence is usually open paniculate Type locality canyon of the Gunnison River, near Cimmaron, Colorado

A Pringlei Greenm, Proc Amer Acad. 40 50, 1904 Heads larger than usual, containing twice the average number of florets for the species as a whole in the type collection (*ca* 18 involucral bracts, 14–18 ray florets, 20–34 disk florets), but subject to considerable variation in the region from which the type came Not readily separable by any character from *Carruthii*. Type locality plains near the city of Chihuahua

A Wrightii coloradensis A Nels. in Coult. and Nels, Man Rocky Mt. 568, 1909

A mexicana Bakeri A Nels., *ibid.* 569

A vulgaris ssp *Wrightii* Hall et Clem, Carn Inst Wash Publ 326 80, 1923.

A vulgaris var *Wrightii* Palmer et Steyerm, Ann Mo Bot Gard. 22.677, 1935, Rhodora 40 134, 1938

A vulgaris Carruthii F. C Gates, Trans Kansas Acad Sci. 42 138, 1940

A Carruthii var. *Wrightii* Blake, Jour Wash Acad. Sci. 30.472, 1940

Stems 3–6 dm tall, herbage white-tomentose throughout or the upper surface of the leaves green; leaves divided into divaricate linear-filiform lobes, these sometimes again toothed, 1–3 cm. long, those of sterile shoots and of the inflorescence often entire, reduced, the margin closely revolute; inflorescence a leafy narrow spike-like panicle, 1–3 cm. wide, occasionally rather expanded;

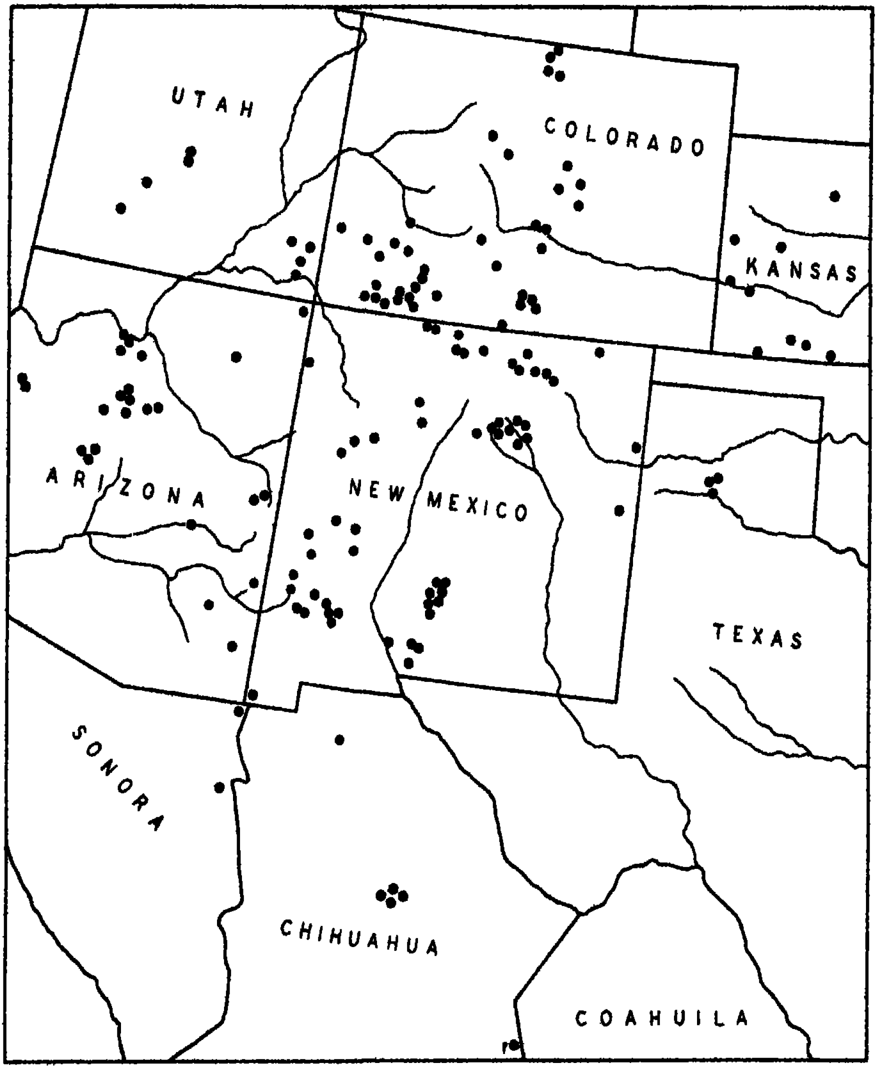


Figure 18 Distribution of *A Carruthii*

heads small, nodding when young, involucre campanulate, 3–3 5 mm. high, 1 5–3 mm wide, tomentulose, often shining, with 8–14 bracts; ray-florets 6–14, disk-florets 6–20 *n* = 9

Western Kansas and northern Texas to central Utah, Arizona, and northern Chihuahua, at elevations from 800 to 3000 m Adventive in Rhode Island, Indiana, Missouri, and eastern Kansas. Flowering from late July through September.

KANSAS. Rooks Rockport Lane· plains, Aug 15, 1895, *Hitchcock 302* (NY, type of *A kansana;* isotypes, RM, US). Greeley: Tribune. Kearney *Hitchcock*. Hamilton Syracuse, *Rose and Fitch 17010* Clark *White* Meade Meade Seward Liberal TEXAS Potter Amarillo, *Bailey 128* Randall· Paloduro Canyon COLORADO Larimer· Dale Creek, Sept. 7, 1899, *Osterhout 2010* (RM, type of *A. coloradensis,* isotypes, NY, Po, RM) Eagle Red Cliff Park Como Douglas Pine Grove El Paso Palmer Lake, Colorado Springs Teller Florissant Fremont Canon City, Wet Mountain Valley Saguache Marshall Pass, 10,000 ft, *Baker 879,* San Luis Valley Montrose Bedrock. Gunnison Black Canyon, *Baker 698* (C, NY, Po, RM, SU, US, topotypes of *A Bakeri*). Ouray 5 mi. N of Ouray San Miquel Norwood Hill Huerfano Cucharas Valley Costilla La Veta Pass Mineral Wagon Wheel Gap Hinsdale Lake City Archuleta Piedra La Plata W of Hesperus NEW MEXICO Union Folsom Colfax· Ute Park. Rio Arriba Dulce San Juan Tunitcha Mts, *Standley 7622* Quay: Nara Visa, Llano Estacado. San Miguel, Las Vegas Santa Fe Canoncito Sandoval: Jemez Springs. Valencia Grants Lincoln Ruidoso Dona Ana Organ Mts Socorro Negrito Ranger Station. Catron Patterson Grant Santa Rita del Cobre, *Wright 1279* (Gray Herb, type of *A Wrightii,* isotype, NY, phototypes, C, NY), N of Cliff Hidalgo: Cloverdale, *Mearns 456* UTAH Sevier Mt Marvin, *Rydberg and Carlton 7567* Piute. Circle Valley Garfield Panguitch Lake San Juan Montezuma Canyon, E of Monticello, *Rydberg and Garrett 9687,* Elk Mts, Bluff ARIZONA. Apache Carrizo Mts., *Standley 7510,* Greer Navajo Oraibi, *Voth 76* Coconino· Grand Canyon, Mt Humphreys, 7 mi E of Flagstaff, Bellemont, *Jones 4074,* Williams. Mohave Hualpai Mts, *Kearney and Peebles 12727* Yavapai Prescott Gila· Black River Bridge Greenlee Metcalf Graham Mt Graham Cochise Chiricahua Mine, *Blumer 1794* CHIHUAHUA. Lake Santa Maria, plains near Chihuahua, *Pringle 625* (Gray Herb, type of *A Pringlei,* isotypes, Ph, SU, US), Santa Eulalia Plains, *Wilkinson.* CHIHUAHUA or COAHUILA Charco de Grado, Oct 1852, *Thurber 791.* SONORA San Luis Mts, *Mearns 2461,* Badehuachi, *Lloyd 404*

Chromosome counts were made in root-tips of three plants grown from seed from Springer, Colfax County, New Mexico, and kindly supplied by Mrs Gladys Nisbet

In Colorado, on the one hand, occasional collections appear to be intermediate with the *Brittonii* form of *A ludoviciana typica,* while in New Mexico, on the other, certain collections are found that are intermediate with *A ludoviciana mexicana* More chromosome counts will help clarify this situation and show whether, as is now suspected, all forms of *ludoviciana* are tetraploid, and of *Carruthii* diploid

6 **Artemisia ludoviciana** Nutt, Gen 2 143, 1818

6a **Artemisia ludoviciana** Nutt ssp. **typica** Keck, Carn Inst Wash Publ 520.330, 1940

Figures 7, 10, and 14

Type statement· "On the banks of the Mississippi, near St Louis; also on the alluvial plains of the Missouri." A specimen at Philadelphia from St Louis, collected and starred by Nuttall, is the type It consists of only four leaves, lightly tomentose above and densely tomentose beneath Another Nuttall specimen at Philadelphia, labeled by Nuttall "Artemisia Ludoviciana. Platte plains," is not starred, but is a large branch in flower with all leaves entire and tomentose on both sides.

Artemisia ludoviciana NUTT., *loc cit*

A gnaphalodes NUTT., *ibid* Type statement "On dry savannahs about Green Bay, Lake Michigan, and on the banks of Fox river, and the Missouri" A starred specimen at the Philadelphia Academy, collected by Nuttall at St Louis, was considered by Hall and Clements to be the type, but its location is inconsistent with the type statement. It consists merely of the top of a flowering stem, in which the leaves are white tomentose on both sides See discussion of this synonym on p 423

A Purshiana BESS in Hook., Fl Bor Amer 1 323, 1833 Type locality "On the plains of the Saskatchewan *Dr Richardson Drummond*" See the following

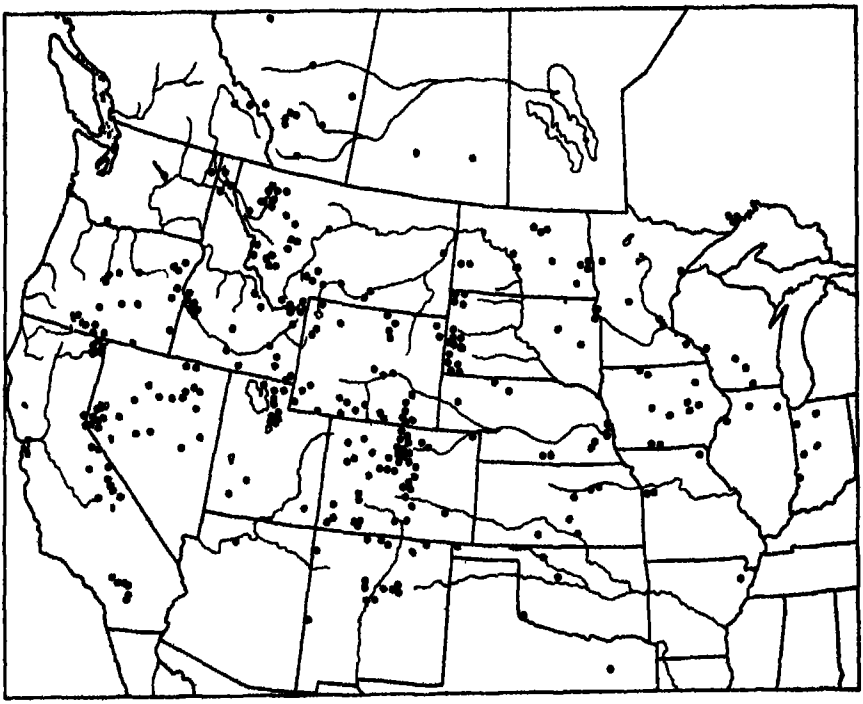


Figure 14 Distribution of *A ludoviciana* ssp *typica*

A Purshiana α *latifolia* BESS., *ibid* Specimen at Kew (Herb Hooker), which has been studied, taken in the Rocky Mts by Drummond, is doubtless of the type collection. By his var *latifolia*, Besser meant the typical form of *Purshiana* (as both species and variety seem to rest on the same type) as contrasted with his var β *angustifolia*, also described here and based on a plant from "Red River. *Douglas, in Herb Lindl.*," which is said to have lanceolate leaves 1½ inches long and 3 lines wide From this description it appears probable that this variety, too, is referable here

A. ludoviciana var *gnaphalodes* TORR. et GRAY, Fl N Amer 2 420, 1843.

A. ludoviciana var *latifolia* TORR. et GRAY, *ibid.*

A vulgaris var *gnaphalodes* O KUNTZE, Rev 1 309, 1891

A vulgaris var *ludoviciana* O KUNTZE, *ibid.*

A rhizomata A NELS., Bull Torr Club 27 34, 1900 A narrow leaved form Type locality Sweetwater River, Wyoming

A. rhizomata var. *pabularis* A. Nels., *ibid.* A small form of the preceding. Type locality: Red Desert, near Creston, Wyoming.

A. diversifolia Rydb., Bull. Torr. Club 28: 20, 1901. A form with the principal leaves merely pinnately cleft, but the few lobes very narrow and acuminate. It closely resembles forms of ssp. *candicans* from the general region of northern Idaho, and should perhaps be interpreted as a transitional form. Type locality: Priest River, Idaho.

A. silvicola Osterh., Bull. Torr. Club 28: 645, 1901. A form with lanceolate, nearly entire, strongly discolored leaves and large heads. Type locality: MacIntyre Creek, Larimer Co., Colorado.

A. Brittonii Rydb., Bull. Torr. Club 32: 129, 1905. Leaves short, with 3 to 5 short rather divergent lobes, heavily tomentose on both sides. Type locality: Golden, Colorado.

A. pudica Rydb., *ibid.* 130. Inflorescence loosely branched, the large heads nodding, leaves rather thin and elongated. A spasmodic variant from widely scattered stations in the Colorado Rockies. Perhaps usually a shade modification. Type locality: Gunnison.

A. pabularis Rydb., *op. cit.* 33: 157, 1906.

A. gnaphalodes diversifolia A. Nels. in Coult. and Nels., Man. Rocky Mt. 569, 1909.

A. mexicana silvicola A. Nels., *ibid.*

A. Herriotii Rydb., Bull. Torr. Club 37: 455, 1910. A large leaved form from Edmonton, Alberta.

A. cuneata Rydb., N. Amer. Fl. 34: 269, 1916. Leaves cuneate obovate, with a few salient teeth around the wide apex. Type locality: Idaho Springs, Colorado.

A. argophylla Rydb., *ibid.* 274. A robust form with exceptionally large heads. The type, from Longs Peak, Colorado, is well east of the range of ssp. *candicans*, which form it resembles.

A. vulgaris ssp. *ludoviciana* Hall et Clem., Carn. Inst. Wash. Publ. 326: 76, 1923.

A. vulgaris ssp. *gnaphalodes* Hall et Clem., *ibid.* 77.

A. ludoviciana var. *pabularis* Fern., Rhodora 47: 248, 1945.

A. ludoviciana var. *Brittonii* Fern., *ibid.*

A. ludoviciana var. *cuneata* Fern., *ibid.*

Stems 3–10 dm. tall, slender to moderately stout, herbaceous to base; leaves many, linear to lanceolate, oblanceolate or elliptic, sometimes cuneate, entire or few-toothed or -lobed especially apically, the lobes regularly entire, 3–10 cm. long, permanently and densely white-tomentose on both sides or loosely floccose to green and glabrate above, plane; inflorescence an elongated usually compact panicle, 1.5–5 cm. broad; heads medium-sized, erect or nodding, often in glomerules; involucre ovoid to campanulate, 3–4 mm. high, 2–3 mm. wide, usually densely tomentose, occasionally glabrate, with 7–13 bracts; ray-florets 5–12; disk-florets 6–21. $n = 18$.

Lowlands and mountains up to middle elevations (2200 m., or occasionally up to 2900 m. in the Colorado Rockies) from Ontario to Alberta, Washington, California, New Mexico, and Arkansas; sporadically introduced from Indiana to Virginia, New England, and Quebec. Flowering from July through September.

ONTARIO. Thunder Bay: near Fort William. SASKATCHEWAN. Assiniboia, Indian Head, *Macoun 10984*; Ribstone Creek; Moose Jaw, *Johnson 969*. ? province, plains of the Saskatchewan, *Drummond* (Kew, type(?) of *A. Purshiana* var. *latifolia*). ALBERTA. Stettler District, Donalda to Bashaw; Peace River; Grand Prairie; Edmonton, *Macoun and Herriot 72895* (NY, type of *A. Herriotii*); Rosedale, *Moodie 1183*; Banff; Lethbridge. BRITISH COLUMBIA. Kootenay: Beavermouth, *Shaw 1153*; Natural Bridge, *Ulke*. INDIANA. Marshall, Fulton, Newton, and Sullivan counties ILLINOIS Dupage, Ogle, and Rock Island counties WISCONSIN La Crosse, Sauk, Dane, and Rock counties MINNESOTA St Louis, Norman, Traverse, Winona, Pope, and Hennepin counties. IOWA Emmet, Fayette, Linn, Benton, Poweschiek, Boone, and Decatur counties MISSOURI Clark *Mead* Jackson Sibley ARKANSAS Craighead S of Jonesboro, *Demaree 7179* NORTH DAKOTA Cass, Ranson, Stutsman, Benson, Burleigh, McLean, and Golden Valley counties SOUTH DAKOTA Grant, Spink, Kingsbury, Harding, Butte, Meade, Lawrence, Custer, and Fall River counties NEBRASKA Douglas, Cass, Lancaster, Kearney, Brown, and Cherry counties KANSAS Riley, Saline, McPherson, Sedgwick, and Pratt counties OKLAHOMA Woods, Cimmaron, Kingfisher, and Harmon counties. TEXAS Wood *Reverchon 3961* MONTANA Richland, Glacier, (Glacier National Park), Flathead, Sanders, Lewis and Clark, Yellowstone, Cascade, Carbon, Sweetgrass, Park, Gallatin, Jefferson, Deer Lodge, Silver Bow, Ravalli, and Beaverhead counties. WYOMING *Crook*, Albany, Sheridan, Johnson, Natrona, Park (*Yellowstone National Park*), Teton, Lincoln, Carbon, Sweetwater, and Uinta counties COLORADO Sedwick Julesburg. Weld. New Windsor Larimer McIntyre Creek, Aug 24, 1900, *Osterhout 2848* (NY, type of *A silvicola*, isotypes, C, RM, US), Meadows Inn, Longs Peak, Aug 14, 1907, *Clements* (NY, type of *A argyrophylla*). Boulder Foot of Flagstaff Mt, *Ewan in Pl Exsic Gray 897* Routt · S of Steamboat Springs. Jefferson Golden, Oct 8, 1882, *N L. Britton* (NY, type of *A Brittonii*) Grande: Hot Sulphur Springs Clear Creek Idaho Springs, *Shear 4617* (NY, type of *A cuneata*) Rio Blanco Buford Garfield Glenwood Springs, *Eggleston 14982* Otero La Junta. Fremont Canon City, *Brandegee 501* Huerfano Cucharas Valley Alamosa Alamosa Gunnison. Gunnison, *Baker 573* (NY, type of *A pudica*, isotypes, C, CAS, Po, RM, US) Mineral Pagosa Peak, *Baker 634* San Miquel Norwood Hill Montezuma: Mesa Verde National Park NEW MEXICO. Colfax Raton Rio Arriba: Brazos Canyon, Dulce. San Juan Tunitcha Mts. San Miguel Las Vegas Sandoval Sandia Mts, *Ellis 125* Grant mts near Condes Camp, *Wright 1275* UTAH Rich Bear Lake, *Hammond 3879* Box Elder Corinne Weber Ogden Canyon Salt Lake Parleys Park Piute Marysvale, *Jones 5846* San Juan Dry Wash, Abajo Mts, *Ryberg and Garrett 9615*. Iron Parowan ARIZONA Coconino · Grand Canyon, *Eggleston 15665* IDAHO Bonner Slough beach, forest between Priest Lake and East Fork, 630 m, *MacDougal 190* (NY, type of *A diversifolia*, Clarks Fork Valley near Horse Plains, *Leiberg 1582* Kootenai. Coeur d'Alene, *Leiberg 1552* Lemhi Gilmore Fremont Henry's Lake, *Nelson 6796* Bannock Lava. Bingham · Blackfoot Blaine · Ketchum. Twin Falls Shoshone Falls, *Nelson and Macbride 1366* Gem Sweet, *Macbride 1626* NEVADA Elko, Eureka, Lander, Humboldt, White Pine, Nye, Pershing, Churchill, Washoe, Ormsby, Storey, and Lyon counties. WASHINGTON Pend Oreille Kalispell Lake Chelan Lake Chelan Klickitat: Columbia River, *Suksdorf 1610* OREGON Wallowa, Union, Baker, Grant, Deschutes, Crook, Malheur, Harney, Lake, and Klamath counties CALIFORNIA Modoc, Nevada, Mono, Inyo, San Bernardino, and Riverside counties.

Chromosome counts were made both in root-tips and in meiosis of one plant from Manitou and of two plants from Engelmann Canyon, all from El Paso County, Colorado, and in root-tips only of one plant from Leevining, Mono County, California, and of two plants from Upper Fern Valley, San Jacinto Mts., Riverside County, California.

An additional very interesting tetraploid, whose chromosomes were counted in root-tips, is now referred here It was collected in Poopenaut Valley, Tuolumne River, Yosemite National Park, at 1065 m elevation, *Nobs 1* (CI, RM) This plant, from the midst of the area occupied by the hexaploid *A Douglasiana*, near the western base of the central Sierra Nevada, was presumed to be a peculiar form of that species when first studied It had discolored leaves like *Douglasiana*, but these were extremely narrow, those on the upper half of the stem were several centimeters long but less than 5 mm. wide. The lower leaves were oblanceolate and wider (up to 20 mm. including lobes), with rather short forward-projecting lobes in the outer half, precluding the possibility that this could be a form of *A. ludoviciana* ssp. *incompta* carried down from higher elevations. This plant is best explained as a relict of *ludoviciana* ssp. *typica* stranded on the western flank of the Sierra Nevada after most of its fellows had been replaced by the younger species, *Douglasiana*. A similar plant from west of Dunlap, Fresno County, *Keck 1861* (CI, SU), may be the same. This suggests that *ludoviciana* ssp. *typica* once skirted the southern end of the Sierra Nevada in a more continuous distribution.

This is probably the most variable systematic unit in the whole complex, as the long synonymy tends to show. Extremes can be pointed out that appear very unlike, but intermediates link all together. This subspecies intergrades not uncommonly with ssp. *candicans* to the northwest, with ssp. *incompta* to the west, and with sspp. *albula* and *mexicana* to the southwest. It does not overlap the ranges of sspp. *sulcata* and *redolens*. Apparently to a much lesser extent it intergrades with *A. serrata, longifolia,* and *Carruthii*.

In the high Rocky Mountains of northern Colorado there is a form that seems to intergrade with the form of *A. Carruthii* known as *A. coloradensis* Osterh. Because it seems impossible to decide from herbarium material whether this is best assigned to *A. Carruthii* as a subspecies, or to *A. ludoviciana* as a subspecies, the question is left open. Perhaps cytological studies will be ultimately decisive, but we have no living material of it. The following specimens are of this intergrading form, all with small deeply divided leaves, the divisions varying from linear to lanceolate. Colorado: Weld: Windsor, *Osterhout 5041* (RM). Larimer: Pole Hill, *Osterhout 2225* (RM), Cherokee Park, *Nelson 10017* (C, RM), Estes Park, Thompson Canyon, *Johnston 678b* (US). Boulder: Boulder, *Hanson C26* (US). Denver: Denver, *Jones 501c* (Po). Clear Creek: Empire, *Tweedy 5840* (NY, RM); Georgetown, *Shear 4514* (RM); above Silver Dale near Georgetown, July 10, 1878, *Jones* (Po).

6b. **Artemisia ludoviciana** Nutt. ssp. **sulcata** (Rydb.) Keck comb. nov.

Figures 10 and 15

Type locality: Casas Grandes, Chihuahua.

Artemisia sulcata Rydb., N. Amer. Fl. 34: 270, 1916.

Stems 3–12 dm. tall, smooth or tomentose, sometimes rather prominently sulcate; leaves lanceolate, sharply acute, the lower toothed apically with short salient lobes, the upper usually entire, reduced in the inflorescence, commonly thin and rather flaccid, mostly 3–10 cm. long and less than 1 cm. wide (exclusive of lobes), usually bright green above, densely white-tomentose beneath, sometimes ± tomentose above, plane; inflorescence a leafy spreading panicle or sometimes reduced and contracted, heads usually distributed in individual nearly naked racemes and pendant; involucre campanulate, 2.5–3 mm. high,

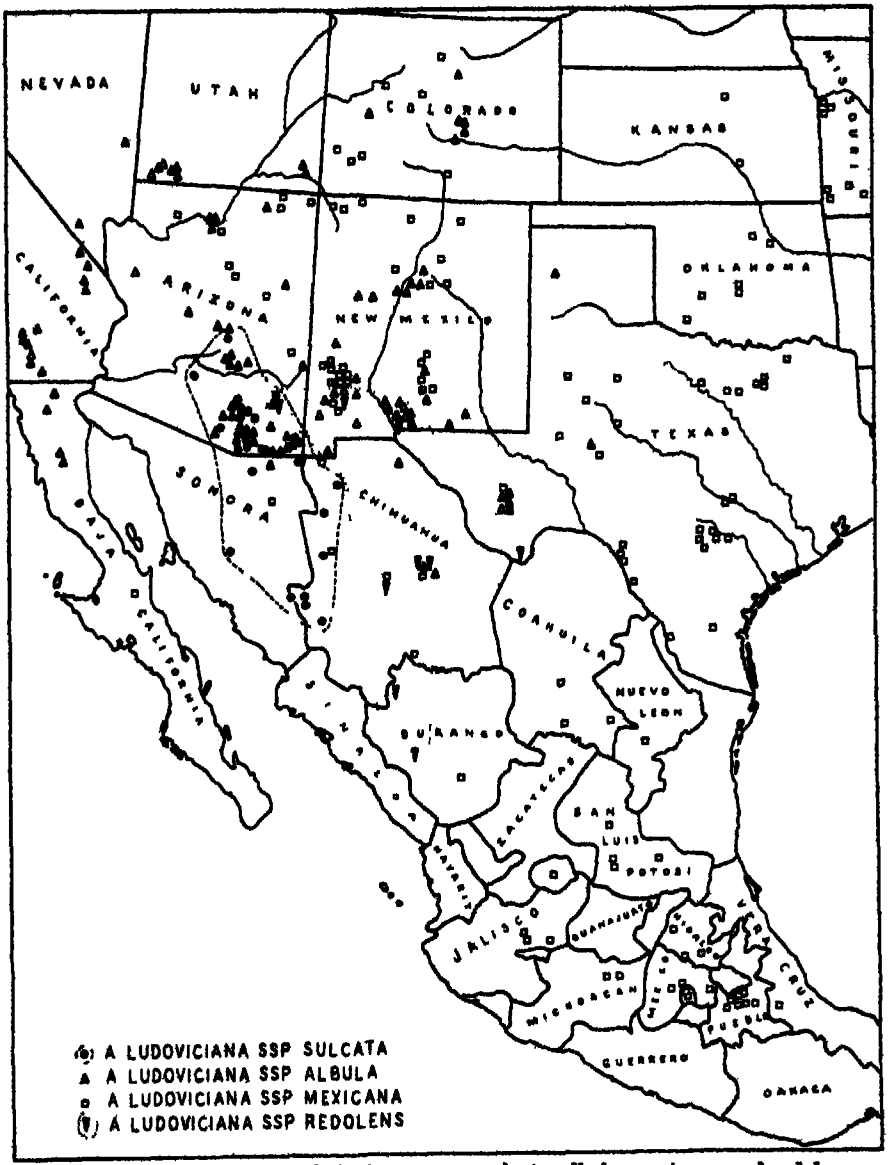


Figure 15. Distribution of *A ludoviciana* sspp. *sulcata, albula, mexicana,* and *redolens.*

2–3 mm wide, usually white-tomentose, sometimes quite glabrate (in Chihuahua, as in the type), with 10–16 bracts; ray-florets 6–16, disk-florets 7–19

High plateaus and mountains from central Arizona to southern Chihuahua, at elevations from 1600 to 2700 m. Flowering from August to October.

ARIZONA. Gila. Upper Tonto Creek, *Harrison and Kearney 8359*. Graham Mt. Graham, 9000 ft., *Kearney and Peebles 9874* Pinal Oracle Maricopa. Sierra Estrella, *Peebles and*

Kearney 7756. Cochise: between Portal and Paradise; Barfoot Park, *Blumer 1389*, Warren; Mule Mts.; Bisbee, Huachuca Mts., Miller Canyon, *Jones 25075*, Ramsey Canyon, *Shreve 5039.* Pima: Santa Catalina Mts., Marshall Gulch, *Shreve 5398*, Ft. Lowell, *Thornber 50*, toward ssp. *mexicana*, Baboquivari Canyon; Rincon Mts., Spud Ranch, *Blumer 3594.* Santa Cruz: Santa Rita Mts., *Kearney and Peebles 10569;* Patagonia Mts. SONORA. Cajon Bonito Creek, near its head, *Mearns 2474*, Cananea, *Donnelly 44*, La Mesa Colorado, *Gentry 559.* CHIHUAHUA. Casas Grandes, August 30, 1899, *Townsend and Barber 437* (NY, type; isotype, US, phototype, C), Chuichupa, Sierra Madre, *Townsend and Barber 483*, Colonia Garcia, Sierra Madre, *Townsend and Barber 326*, Norogachi, *E. Palmer S. 8;* Sierra de Papas, San Jose de Pinal, Rio Mayo, *Gentry 2843.*

In proposing *Artemisia sulcata*, Rydberg emphasized the shining glabrate involucres and the grooved stems. As pointed out by Hall and Clements, these do not furnish good criteria for separating *sulcata* from ssp. *mexicana.* Other characters, however, are more dependable for separating these two units, namely, *sulcata* has entire to apically toothed leaves instead of pinnately divided ones, and these are thin and plane instead of thickish and revolute. As shown in the distribution map, figure 15, the range of ssp. *sulcata* is adjacent to that of ssp. *mexicana* which it largely replaces in southern Arizona.

Artemisia ludoviciana ssp. *sulcata* is wedged between sspp. *mexicana*, *albula*, and *typica.* Intermediates occur between *sulcata* and sspp. *albula* and *mexicana* along the periphery of its range suggesting intercrossing and recombination. Genetic barriers of specific importance have therefore not arisen between these units. Possibly the broader leaves of *sulcata* point to a connection with ssp. *typica.* It appears that ssp. *sulcata* is a recognizable form which may have evolved through the recombination of characters from the three subspecies, *mexicana, albula,* and *typica,* which surround it.

6c. **Artemisia ludoviciana** Nutt. ssp. **albula** (Woot.) Keck comb. nov.

Figures 10 and 15

Type locality: Organ Mountains, New Mexico.

Artemisia microcephala Woot., Bull. Torr. Club 25: 455, 1898; not Hillebr., 1888.

A. albula Woot., Contr. U. S. Nat. Herb. 16: 198, 1913. New name for *A. microcephala* Woot.

Stems 3–10 dm. tall, herbage white-tomentose throughout, rarely the leaves evidently discolored and merely tomentulose on the upper surface, leaves mostly obovate to elliptic, their teeth or lobes projecting forward and not nearly cut to the midrib, the upper ones reduced, often lance-linear and entire, not fascicled, thickish, short (mostly 1–2 cm. long), the margin often narrowly revolute; inflorescence open-paniculate, heads small, racemosely arranged along the elongated divergent remote leafy branchlets, or sometimes ± glomerate, involucre campanulate, *ca.* 3 mm. high, 2 mm. wide, densely tomentose, with 11–16 bracts; ray-florets 8–11; disk-florets 8–13.

Western Texas and southern Colorado to southern Nevada and California, south to northern Baja California, Sonora, and Chihuahua, at elevations from 150 to 2250 m. Flowering from May to October.

TEXAS. Oldham Canadian Valley. Jeff Davis Fort Davis, *Eggleston 17412*, Sawtooth Mt.; Limpia P O COLORADO Boulder Eldorado Springs, *Bartholomew 2* (NY). El Paso. Bear Creek Canyon Fremont Canon City, *Biltmore 1437a.* Delta Paonia, *Eggleston 14954.* NEW MEXICO. Sandoval Sandia Mts., *Eastwood 15650* Bernalillo Albuquerque Valencia. Laguna Catron. Mangas. Lincoln. Gray, *Earle 457.* Sierra· Hillsboro, *Metcalfe 1445* Grant Bear Mt, *Metcalfe 709* Eddy Carlsbad Caverns. Dona Ana Organ Mts., 4500 ft., Sept 1, 1897, *Wooton 504* (US, type, phototypes, C, NY, US, isotypes, NY, US) Luna: Florida Mts Hidalgo Lordsburg, Dog Spring, *Mearns 2370* UTAH. San Juan Butler Wash; Bluff. Washington. Zion National Park, St. George NEVADA. Lincoln Panaca. Clark Charleston Mts, *Coville and Funston 372.* ARIZONA Apache Petrified Forest N of Adamana, *Hall 11171.* Navajo Shonto Coconino Grand Canyon, *Eastwood and Howell 7006* Mohave· White Cliffs E of Kingman Yavapai Weaver Mts, *Gillespie 8498* Gila Payson; Globe Maricopa Fish Creek Pinal. Superstition Mt, *Gillespie 8585* Greenlee Blue River Graham: Ft Grant Cochise Paradise, *Blumer 1798*, Dragoon Pass, *Jones 25623*, Bisbee Pima: Tucson, Baboquivari Canyon CALIFORNIA Tulare Kern River at Funston Creek, 6900 ft, *Sharsmith 3840* San Bernardino Clark Mt., 5 mi S of Barnwell, *Munz 13838*, Providence Mts, Little San Bernardino Mts. Riverside Tahquitz Canyon, Palm Springs, *Wheeler 2296*, San Jacinto River Canyon San Diego Borrego Valley. CHIHUAHUA Candelaria, *Stearns 276*, Sierra en Media, *E W. Nelson 6488*, Santa Eulalia Mts, *Pringle 626* SONORA. San Jose Mts, *Mearns 1055.* BAJA CALIFORNIA Cantillas Mts., 1875, *E Palmer*, between Ojos Negros and Neji Rancho, *Wiggins and Gillespie 4146*, La Encantada, Sierra San Pedro Martir, *Wiggins and Demaree 4877, 4999* (Po, SU, both atypical, toward ssp *sulcata* or *mexicana*)

Hall and Clements included this form under *A. vulgaris* ssp *gnaphalodes*, although they accurately pointed out its outstanding characteristics Blake, in Kearney and Peebles' Flowering Plants and Ferns of Arizona, likewise refers it to *A gnaphalodes* It will be seen from the distribution map that as here circumscribed *A ludoviciana* ssp *typica* (which includes *A gnaphalodes*) and *A ludoviciana* ssp *albula* largely occupy different geographical areas Their different morphological patterns mark them as excellent examples of geographical subspecies

6d **Artemisia ludoviciana** Nutt ssp. **candicans** (Rydb) Keck comb. nov.

Figures 10 and 16

Type locality. Little Belt Mountains, Montana

Artemisia ludoviciana var *latiloba* NUTT, Trans Amer. Phil Soc II, 7 400, 1841 "With the above [*A ludoviciana*], in the Rocky Mountains" According to Rydberg, the same as his *A. platyphylla*, but the entity uncertain, with no type found.

A. candicans RYDB, Bull. Torr Club 24 296, 1897.

A. floccosa RYDB., *ibid* 297. In the type of *candicans* the heads are sessile along the branchlets of the inflorescence and thus rather glomerate, in the type of *floccosa* the heads are short-pediceled and arranged in a long spike like panicle In other respects the two forms are closely similar. Type locality Lima, Montana.

A paucicephala A. NELS, Bull Torr. Club 27·35, Jan 24, 1900 A form with many of the leaves entire and thus allied to ssp *typica*, however, some leaves are deeply parted, and the very large heads ally it more closely to this than to *typica* Type locality· near Yellowstone Lake on the banks of a tributary creek.

A gracilenta A. NELS., *ibid*. A foliage form of the preceding, with the leaves twice cut and the lobes more slender, in this respect comparable with the *Flodmanii* form of ssp *incompta*. Type locality. sandy beaches and banks of Yellowstone Lake.

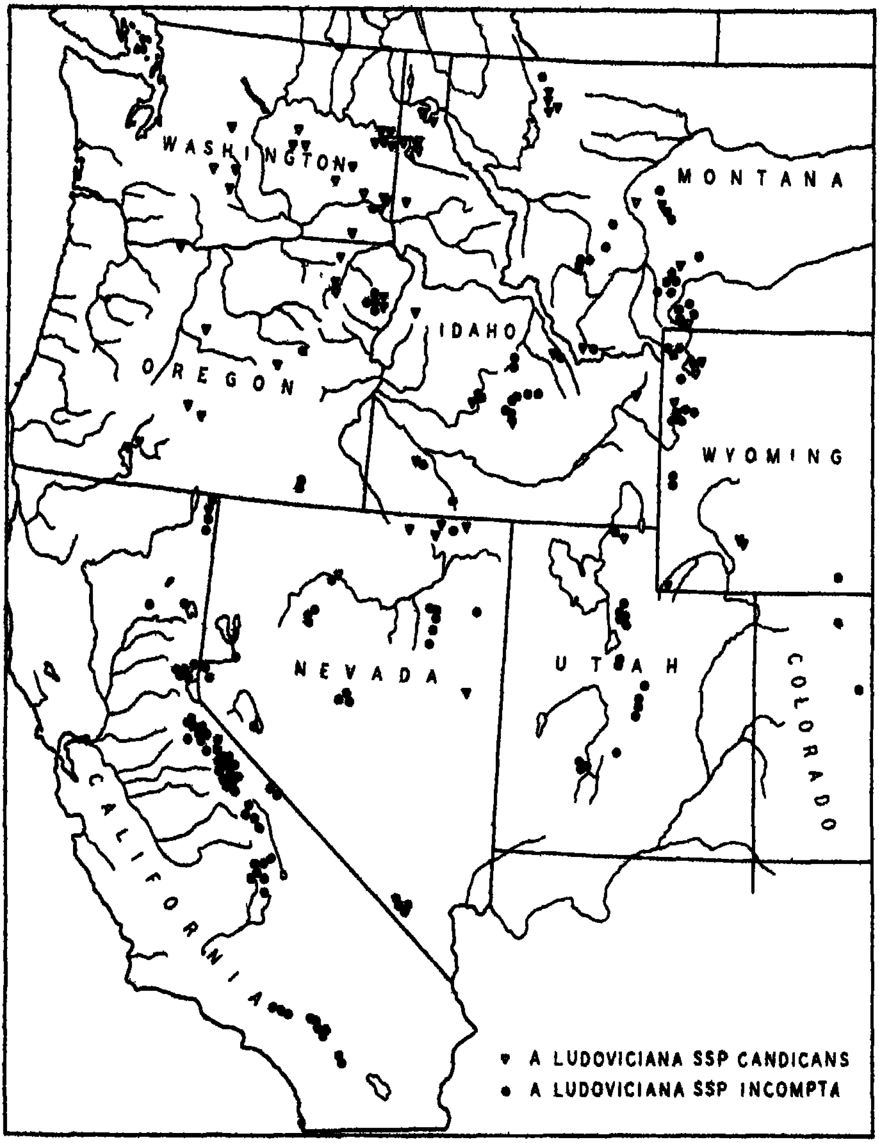


Figure 16 Distribution of *A ludoviciana* sspp *candicans* and *incompta*.

A. latiloba **Rydb.**, Mem N Y Bot. Gard 1·429, Feb 15, 1900.

A platyphylla **Rydb.**, N Amer. Fl. 34 275, 1916. Leaves of the type large and cut much like those of *A Douglasiana*, that is, cuneate-obovate and toothed or short-lobed toward apex, but the inflorescence and pubescence are like *candicans*. Furthermore, a large series of variations from the Spokane region in the Herbarium of the University of California make the complete transition to *candicans*. Ssp *typica* is not only very rare in Washington, but has much smaller heads than this. Although chromosome counts are lacking which would clinch the matter, we suspect *A. Douglasiana* may occur in this region, but in an atypically gray pubescent form The type locality of *A. platyphylla* is sandy or gravelly banks of Spokane River, Spokane, Washington

A vulgaris ssp *candicans* HALL et CLEM , Carn Inst Wash Publ. 326 73, 1923.
A. vulgaris var *candicans* PECK, Man Higher Pl Ore 766, 1941

Stems 3–10 dm tall, entirely herbaceous, herbage white-tomentose throughout, leaves oblanceolate to broadly elliptic in outline, deeply pinnately cleft or parted into forward-projecting narrow lobes, at least some lobes again toothed, or sometimes the leaves merely pinnately lobed and the upper ones entire, 5–10 cm long, 1 5–4 cm wide, sometimes more thinly tomentose on upper surface, but rarely ever green, plane or nearly so, inflorescence a somewhat leafy narrow panicle, the heads borne singly or in small glomerules, large, sometimes nodding, involucre broadly campanulate to hemispheric, 3 5–4 mm high, 3–7 mm wide, tomentose, with 9–14 bracts, ray-florets 7–12, disk-florets 17–42

Lowlands and mountains up to middle elevations (2400 m) from western Montana and Wyoming to northern Utah and westward to central Washington, Oregon, and northern California Flowering from June to September

MONTANA Glacier National Park · Baring Basin, *Standley 17159.* Flathead Summit, Belton Judith Basin Little Belt Mts , 6 mi from Barker, 6000 ft , Aug 18, 1896, *J H. Flodman 882* (NY, type of *A candicans*, isotype, US) Gallatin Sedan. Beaverhead Lima, Aug 6, 1895, *Rydberg 2942* (NY, type of *A floccosa*, isotype, US) Park. Gardiner, *Hawkins 728a* WYOMING Yellowstone National Park Yellowstone Lake, Aug. 22, 1899, *A and E Nelson 6612* (RM, type of *A gracilenta*, isotypes, NY, RM), ditto, Aug 6, 1899, *A and E Nelson 6344* (RM, type of *A paucicephala*, isotypes, NY, Po, RM, SU) Teton. Teton Forest Reservation, *Brandegee* Sweetwater 6 mi N of Rock Springs Uinta West Fork of Bear River, *Payson 4840.* UTAH. Cache Summer Camp, Logan Canyon, *Art Smith* IDAHO Bonner Lake Pend d'Oreille Kootenai Farmington Landing, *Sandberg et al 569*, Couer d'Alene, *Leiberg 1552* Latah Comerine Gulch Lemhi Gilmore Fremont St Anthony Blaine Hailey Custer Alturas Inlet Washington Tamarack, *Clark 227* Owyhee Twilight Gulch, *Macbride 486* NEVADA. Elko Little Lakes Canyon White Pine Duck Creek, Ely, *Mitchcock 1390.* Humboldt Winnemucca, *Griffiths and Morris 40* WASHINGTON Spokane banks of Spokane River, Spokane, June 1897, *Elmer 867* (NY, type of *A platyphylla* , isotypes, Po, US), ditto, Oct 1921, *Moore* (C, a large series of variations) Whitman S E of Lamont, Wawawai, *Keck 382* Columbia Blue Mts Adams Sheep Springs, *Leiberg 944.* Grant : Soap Lake, *Thompson 11795* Chelan · Mt. Stuart Kittitas Ellensburg. Yakima Upper Naches River OREGON Wallowa Joseph, Wallowa Lake Union. La Grande Umatilla Toll Gate Hood River Hood River Grant Izee. Crook Prineville Lake Silver Lake, *Leiberg 758* Klamath Pelican Bay CALIFORNIA Modoc Lily Lake, Pine Creek Nevada ridge S of Donner Pass, 8500 ft , *Heller 7153*

This subspecies occurs through approximately the same geographical region as ssp *incompta*, but for the most part at lower elevations and in a different life zone Transitional specimens are not infrequently found between these two subspecies. Likewise, transitions are sometimes found between ssp *candicans* and ssp *typica* As mentioned under the synonym *A. platyphylla*, forms from Washington are sometimes difficult to separate from *A. Douglasiana*, although presumably the two have a genetic barrier to their interbreeding in a difference in chromosome number It is quite possible that the *Douglasiana*-like forms of *candicans* have arisen independently as a parallel variation and are not the result of *Douglasiana* genes picked up through crossing This possibility gains credence from the complete series of intermediates linking these broad-leaved forms with the narrow-leaved forms of *candicans*.

6e **Artemisia ludoviciana** Nutt ssp **incompta** (Nutt) Keck, Carn Inst Wash Publ 520 327, 1940

Figures 8, 10, and 16

Type statement "In the central chain of the Rocky Mountains, in Thornberg's Pass, near the great passage to the plains of the Oregon." This locality is in Custer County, Idaho, and the type was collected by Nuttall

Artemisia incompta Nutt., Trans Amer Phil. Soc II, 7 400, 1841

A discolor var *incompta* Gray, Syn Fl 1(2) 373, 1884

A atomifera Piper, Contr U S Nat Herb. 11 588, 1906 A form from Wawawai, Washington, on the Snake River, with thick, strongly discolored leaves that are green on the upper surface, and some of which are bipinnately lobed An unusual variant from within the zone of *candicans*, but from its morphology best assigned to *incompta* Wide variation is exhibited at the type locality, so it is impossible to distinguish a separate systematic unit here

A ludoviciana var. *atomifera* M E Jones, Bull Univ. Mont Biol ser 15 48, 1910.

A potens A Nels , Bot Gaz 54.418, 1912. A greenish form very similar to the type of *incompta* taken not far from the type locality of this subspecies Type locality Mackay (Pass Creek), Custer Co , Idaho

A Flodmanii Rydb., N. Amer Fl 34 276, 1916 A densely tomentose form with linear divisions to the leaves, heads medium sized, too small for *candicans* An uncommon form, but principally found in western Montana. Type locality Little Belt Mountains, Montana, 9 miles east of Barker

A vulgaris ssp *Flodmanii* Hall et Clem , Carn Inst. Wash Publ 326 75, 1923

A vulgaris ssp *Michauxiana* var. *incompta* St John, Res Stud St. Coll Wash 1 106, 1929

A. vulgaris var *Flodmanii* Peck, Man Higher Pls Ore 767, 1941

Stems 3–9 dm tall, usually entirely herbaceous, herbage commonly ± green, with leaves glabrate above and white-tomentose beneath, but often ± densely tomentose throughout, and sometimes essentially glabrous throughout, lower leaves mostly obovate to broadly elliptic in outline, rarely fascicled, parted or divided into linear or lanceolate often elongated forward-projecting lobes, some of these again toothed or lobed, 2–8 cm long, the upper leaves less cut or even entire, the margin rarely revolute, inflorescence a narrow spike-like or even racemose panicle, sometimes much broader but not open, not very leafy, heads rather large, nodding at first or erect, involucre broadly campanulate, 3–3 5 mm high, 2.5–4 mm wide, sericeous-tomentose to glabrate and shining, with 9–14 bracts, ray-florets 6–10; disk-florets 15–30(–45) $n = 18$.

Mountains of Montana and Idaho, southward to central Utah, Nevada and California, at elevations from 1400 to 3000 (to 3500) m. Flowering from July through September.

MONTANA. Glacier: Swiftcurrent Creek, *Standley 16071* Cascade Belt Creek Judith Basin Little Belt Mts, 9 mi from Barker, Aug 18, 1896, 6,000 ft, *Flodman 883* (NY, type of *A Flodmanii*, isotype, US) Sweet Grass Sweet Grass Canyon, Crazy Mts. Lewis and Clark, Gate of the Mountains Jefferson Boulder Creek Silver Bow: Durant. Gallatin. Bridger Mts, Aug 21, 1902, *W W Jones* Park Emigrant Gulch, *Rydberg and Bessey 5206* Beaverhead Lima, *Shear 5062* WYOMING Yellowstone National Park Madison River. Teton: Government Bridge, Jackson Hole, *Payson 2264*. Lincoln Salt River Mts. E of Smoot Carbon Bridger Peak COLORADO Routt: Anita Peak, *Goodding 1753* Eagle Red Cliff UTAH Cache Tony Lake basin, *Maguire 16105* Salt Lake Alta Utah Mt. Timpanogas Juab Mt Nebo San Pete Reeder Canyon Sevier Fish Lake (C), head of Bullion Creek, 11,500 ft, *Jones 5873* IDAHO Lemhi Gilmore, *Hall 11552* Custer Garden Creek, near Challis, *Macbride and Payson 3350*, Mackay, Pass Creek, 6,700 ft, July 30, 1911, *Nelson and Macbride 1413* (RM, type of *A potens*, isotypes, C, NY, Po, SU, US), Mackay, Bear Canyon, *Nelson and Macbride 1521*, Thornberg's Pass, *Nuttall* (Ph, type of *A incompta*) Blaine Alturas Lake, Ketchum. Owyhee Twilight Gulch, *Macbride 485* NEVADA Elko Coon Creek, Jarbidge Mts (SU), Spruce Mt, Lamoille Canyon White Pine Sherman Peak, Ruby Mts, *Hitchcock and Martin 5651* Pershing Star Peak, *Watson 638* Lander 35 mi S W of Austin, W of Bunkerhill Mt Humboldt Winnemucca, Humboldt Canyon, *Heller 10625* Washoe Galena Creek, Mt Rose Mineral Walker Lake, *Tidestrom 10157* Clark Rainbow Falls, Charleston Mts, *Clokey 7388* WASHINGTON. Whitman: Wawawai, Sept 1903, *C V Piper 6466* (US, type of *A atomifera*, isotypes, CAS, NY, SU, US) OREGON Wallowa Lake, Bear Creek, *Sheldon 8809*, West Fork, Wallowa River, *Keck 366* Grant Strawberry Mt Harney base of Steins Mts CALIFORNIA. Modoc Cedar Mt Lassen Janesville Plumas Prattville Nevada Soda Springs Placer Summit, *Heller 12898* Alpine Ebbet Pass, Sonora Pass Mono Blue Lake, Leevining Grade, *Keck 5015*, McAfee Meadows, White Mts, 11,500 ft, *Duran 2834* (C, SU, with small finely cut leaves like the *tenuis* form of *A Michauxiana*) Tuolumne Upper Relief Valley, Tuolumne Meadows Mariposa Washburn Lake Madera Merced Pass, *Bolander 6159* Inyo Piute Pass North Lake Trail, *Ferris 8937*, Mt Baxter Tulare Kaweah Peaks, trail to Mt Whitney, *Culbertson in Baker 4341*, Little Kern, Junction Meadows Los Angeles Swartout Valley, *Munz 7711*, Pine Mt. ridge, *Johnston 1651* San Bernardino Vivian Creek, Big Meadows of Santa Ana, Dry Lake, Mt San Gorgonio Riverside Strawberry Valley, San Jacinto Mts, *Wheeler 171*

Chromosomes were counted in meiotic divisions of two plants from Yosemite Creek, Tioga Road, Yosemite National Park, at 2200 m elevation, and in somatic divisions in root-tips of a plant from White Mountain, Yosemite National Park, at 3200 m, and of another from Slate Creek Valley, Mono County, California, at 3260 m elevation An additional plant from Slate Creek Valley proved to be hexaploid, with $2n = ca$ 54 (See Clausen, Keck, and Hiesey, 1940a, p 336, for additional information on this plant)

As is the case with most of the other units in this complex, ssp *incompta* is extremely variable, and many collections included here neither fully fit the description nor bear a close resemblance to even neighboring collections The closest resemblance of ssp *incompta* within the species is to *typica* and *candicans*. Intergrades are not rare As shown in the map, figure 16, ssp *incompta* ranges farther south than ssp *candicans*. The exact boundaries cannot be automatically determined. For instance, on the higher summits of the Wasatch Range in San Pete County, Utah, far south of the range of typical *candicans*, four collections have been studied all of which bear a morphological resemblance to *candicans*, but which might be classed as intermediates. From their occurrence well within the region of *incompta* and their transitional appearance, these are considered an example of parallel variation within *incompta* rather than representatives of *candicans* of disjunct distribution.

The relationships of ssp *incompta* outside the species are with *A. Michauxiana* and *Lindleyana*. This is suggested, also, in figure 19, page 466 The breaks between these units, however, seem to be more clear cut than those between the subspecies of *ludoviciana*, and this helps justify the maintenance of species instead of subspecies A thorough cytological survey should precede drastic taxonomic shifts in this group

6f **Artemisia ludoviciana** Nutt subsp **mexicana** (Willd) Keck comb nov.

Figures 10 and 15

Type locality Mexico. Type not seen

Artemisia mexicana Willd in Spreng , Syst 3.490, 1826

Oligosporus mexicanus Less , Syn. Gen Compos. 264, 1832.

Artemisia indica mexicana Bess , Nouv Mém. Soc Nat Mosc 3 56, 1834

A vulgaris var *mexicana* Torr. et Gray, Fl N. Amer 2 421, 1843

A. cuneifolia Scheele, Linnaea 22:162, 1849 Type not seen, but according to Hall and Clements this is a tall, very erect and rigid, small headed form of the subspecies here considered. Type locality. high places on the prairie near New Braunfels, Texas

A Lindheimeriana Scheele, *ibid.* 163 Type not seen, but according to Hall and Clements stems rigid and almost woody, heads only 2 mm. across Type locality in the dry river bed of the Cibolo, fifteen miles west of New Braunfels, Texas

A Underwoodii Rydb., Bull Torr. Club 32.129, 1905 A form with the deeply lobed, strongly discolored foliage of *mexicana* and the compact spike like panicle of *typica*, to which it is rather intermediate Type locality Ouray, Colorado.

A. revoluta Rydb., N Amer Fl 34 272, 1916. Form with very narrow, elongated, revolute divisions of the leaves and a narrow inflorescence Type locality city of Chihuahua.

A texana Rydb , *ibid.* 274 Intermediate to *typica*, with broad leaves, the upper of which are entire Judging from its distribution and the presence of intergrades, a tomentose form of *mexicana* Type locality Colorado, Texas.

A Ghiesbreghtii Rydb , *ibid* 271 An exceptionally large headed form of *mexicana*, but lacking the type of *mexicana*, and finding head size a variable character in Mexico, it seems best to put this into synonymy here. Type locality Chiapas

A Muelleri Rydb , *ibid* 270 A form with rather wide mostly entire upper leaves. Type locality Orizaba.

A neomexicana Greene ex Rydb., *ibid.* 279. A narrow leaved form approaching *A Carruthii*, strongly discolored, inflorescence rather narrow for the subspecies. Type locality· in a grassy glade, Hillsboro Peak, Black Range, New Mexico.

A vulgaris ssp *mexicana* Hall et Clem., Carn Inst. Wash Publ. 326 80, 1923

A ludoviciana Lindheimeriana Bush, Amer. Midl Nat 11 35, 1928,

A ludoviciana var. *mexicana* Fern , Rhodora 47 248, 1945

Stems 3–10 dm tall, densely leafy, herbaceous to base, leaves variable, typically 5–10 cm long, with few linear pinnate spreading entire divisions 2–4 mm. wide, but the upper and many of the cauline often entire or nearly so, and the lower cauline often merely ternately divided, loosely floccose to glabrous and dark green above, densely white-tomentose beneath, often thickish, narrowly revolute, inflorescence a rather dense leafy branching panicle 3–10 cm. broad, heads rather small, erect or more commonly nodding, involucre turbinate to campanulate or hemispheric, 2 5–3 5 mm high, 2–3 mm wide, sparingly to densely tomentose, with 10–15 bracts, ray-florets 5–12, disk-florets, 6–18

Western Missouri to Colorado, Arizona, and southward to Guatemala, at elevations from 250 to 3050 m Flowering from August through October Type locality · Mexico

MISSOURI Jackson Courtney, *Bush 6509* Greene Springfield, *Standley 8637* ARKANSAS Pulaski: Little Rock, Sept. 1886, *Hasse* (SU) KANSAS Cloud. Aurora, *Fraser 553* Sedgwick · Wichita OKLAHOMA. Creek, Payne, Cleveland, Caddo, and Kiowa counties TEXAS. Fannin, Dallas, Tarrant, Parker, Young, Dickens, Lubbock, Garza, Midland, Tom Green, Jeff Davis, Travis, Kendall, Comal, Bexar, Valverde, Maverick, Webb, and Duval counties Mitchell Colorado, *Tracy 8141* (NY, type of *A texana*, isotypes, NY, US) COLORADO Larimer Moraine Park, *Osterhout 3130* (RM, atypical) Summit Breckenridge, *Mackenzie 287* (NY, atypical) Garfield · Glenwood Springs, *Osterhout 3309* (RM, atypical) Ouray chaparral covered hills S E of Ouray, *Underwood and Selby 74* (NY, type of *A. Underwoodii*, phototype, C) Montrose Naturita, *Payson 590* San Miguel Telluride, 10,000 ft, *Tweedy 332* NEW MEXICO Colfax, Rio Arriba, San Juan, Sandoval, Lincoln, Otero, Catron, and Sierra counties Grant Hillsboro Peak, Black Range, *Metcalfe 1848* (NY, type of *A neomexicana*, phototype, C, isotypes, CAS, Po, RM, US) ARIZONA Apache Carrizo Mts, Hannagan Meadow, White Mts, 1935, *McNeill* Navajo Kayenta, Holbrook Coconino Grand View, Grand Canyon, *Eastwood 3611* (CAS, toward *albula*), S of Flagstaff SONORA Halfway between Cumpas and Baviacora, *Drouet et al 3654* CHIHUAHUA Boundary, near White Water, *Mearns 2281*, Soldier Canyon, Sierra Madre, Colonia Garcia, *Townsend and Barber 296*, by streams near Chihuahua, *Pringle 890* (NY, type of *A revoluta*, phototype, C, isotypes, NY, Ph), between Porral and San Julian, *E W Nelson 4039* (US, toward *redolens*) COAHUILA Soledad, *E Palmer 736* (toward *albula*), Sierra de Parras, *Purpus 4659* (toward *Carruthii*), Saltillo, *E Palmer 286* (possibly a distinct subspecies, with broad, venulose, involute margined, tomentose leaves like some Texan forms but showing some characters of *typica*) NUEVO LEON Galeana, *Taylor 207* DURANGO Durango, *E Palmer 600, 601, 602, 907*. SAN LUIS POTOSI Alvarez, *E. Palmer 59*, San Luis Potosi, *Parry and Palmer, 530, 531* AGUASCALIENTES Aguascalientes, *Rose and Painter 7760* JALISCO Rio Blanco; Guadalajara, *Pringle 8765* HIDALGO Dublan, Pachuca, Tula, *Pringle 9848* MEXICO Contadero; Eslava FEDERAL DISTRICT Mexico City MICHOACAN Morelia VERA CRUZ Orizaba, *Fred Müller 235* (NY, type and isotype of *A Muelleri*) PUEBLA Puebla CHIAPAS Without exact locality, *Ghiesbrecht 155* (NY, type of *A Ghiesbreghtii*, the spelling inadvertently (?) altered by Rydberg) GUATEMALIA San Pedro S, *Tejada 49* (US). Apparently introduced and cultivated in San Salvador, *Calderon 2255* (US), where the collector reports it to be "much used by native people as remedy for various affections"

At least as variable a subspecies as *typica*, but difficult to subdivide further on the basis of present collections. Undoubtedly distinct ecotypes remain to be worked out in the Mexican highlands A few forms, now puzzling, await a fuller understanding before adequate treatment For example, a collection from San Pablo, Baja California, collected April 21, 1889, by T S Brandegee (C), from well outside the range of this otherwise fall flowering subspecies, is best referred here temporarily on the basis of form Intergrades link ssp *mexicana* with ssp *typica*, *albula*, and *redolens*.

6g. **Artemisia ludoviciana** Nutt ssp **redolens** (Gray) Keck comb nov.

Figures 10 and 15

Type statement "Chihuahua, on cool slopes under cliffs, *Pringle,* 296 "

Artemisia redolens Gray, Proc Amer Acad. 21 393, 1886.
A vulgaris ssp *redolens* Hall et Clem , Carn Inst Wash Publ 326 75, 1923

Stems 4–8 dm tall, herbage quite glabrous throughout and glandular-atomiferous to moderately tomentose, especially on under surfaces of leaves, leaves broadly ovate in outline, the lower bipinnately dissected, the salient lobes rather narrow and short (mostly less than 1 cm long), 2–5 cm long, nearly as wide, the upper toothed to entire, narrowly linear, the margin sometimes narrowly revolute, inflorescence a broad leafy panicle with ascending branches bearing small usually erect heads in delicate racemes, involucre broadly campanulate, 2.5–3 mm high, 3 mm wide, sparingly silky tomentose, with 12–14 bracts, ray-florets 6–10, disk-florets 8–14

Westernmost Texas, southern New Mexico and southeastern Arizona (in somewhat atypical form) to Chihuahua and Durango, at elevations from 1800 to 2500 m

TEXAS Brewster. Chisos Mts., *Mueller 8242* NEW MEXICO Dona Ana Organ Mts , Sept. 23, 1906, *Wooton and Standley* Grant Copper Mines (Santa Rita), *Wright 1878,* in part (Ph) ARIZONA Graham Mt Graham, 7500 ft , *Kearney and Peebles 9796* (possibly a form of *A Carruthii*) CHIHUAHUA. In shade of cliffs, rocky hills near Chihuahua, *Pringle 296* (Gray, type, isotypes, NY, Ph, US), *1059*, Soldier Canyon, Sierra Madre, *Jones* DURANGO San Julian to Cerro Prieto, *E W Nelson 4956*, Sandia Station, *Pringle 13535*

This unit is somewhat variable and its distribution is within the region occupied by ssp *mexicana* However, the distinctive foliage and sparse pubescence serve to distinguish it from *mexicana,* so that it appears to be quite apart A very few intermediates are found The lower leaves of spp *redolens* are bipinnately dissected like those in *A Michauxiana,* a form very different otherwise and from an entirely different habitat in the northern Rockies, but the correspondence in leaves is suggestive. Possibly each of these units will prove to have a different chromosome number from *A ludoviciana,* and each may have had a long independent history behind it

7 **Artemisia Lindleyana** Bess. in Hook , Fl. Bor Amer. 1 322, 1833

Figures 10 and 17

Type statement. "North-West coast of America *Douglas,* in *Herb. Lindl n* 16 " The following three collections in the Kew Herbarium, collected by David Douglas, may include an isotype of the species abundantly on the sands of the seashore near the straits of Juan de Fuca, 1825, *Douglas* (Hb. Benth , I doubt the locality on this label) ; in the channels of mountain streams near the sources of the Columbia, common, *Douglas* (possibly a part of the previous collection, in which case these data as to the source are probably correct) ; Columbia River, 1830, *Douglas.*

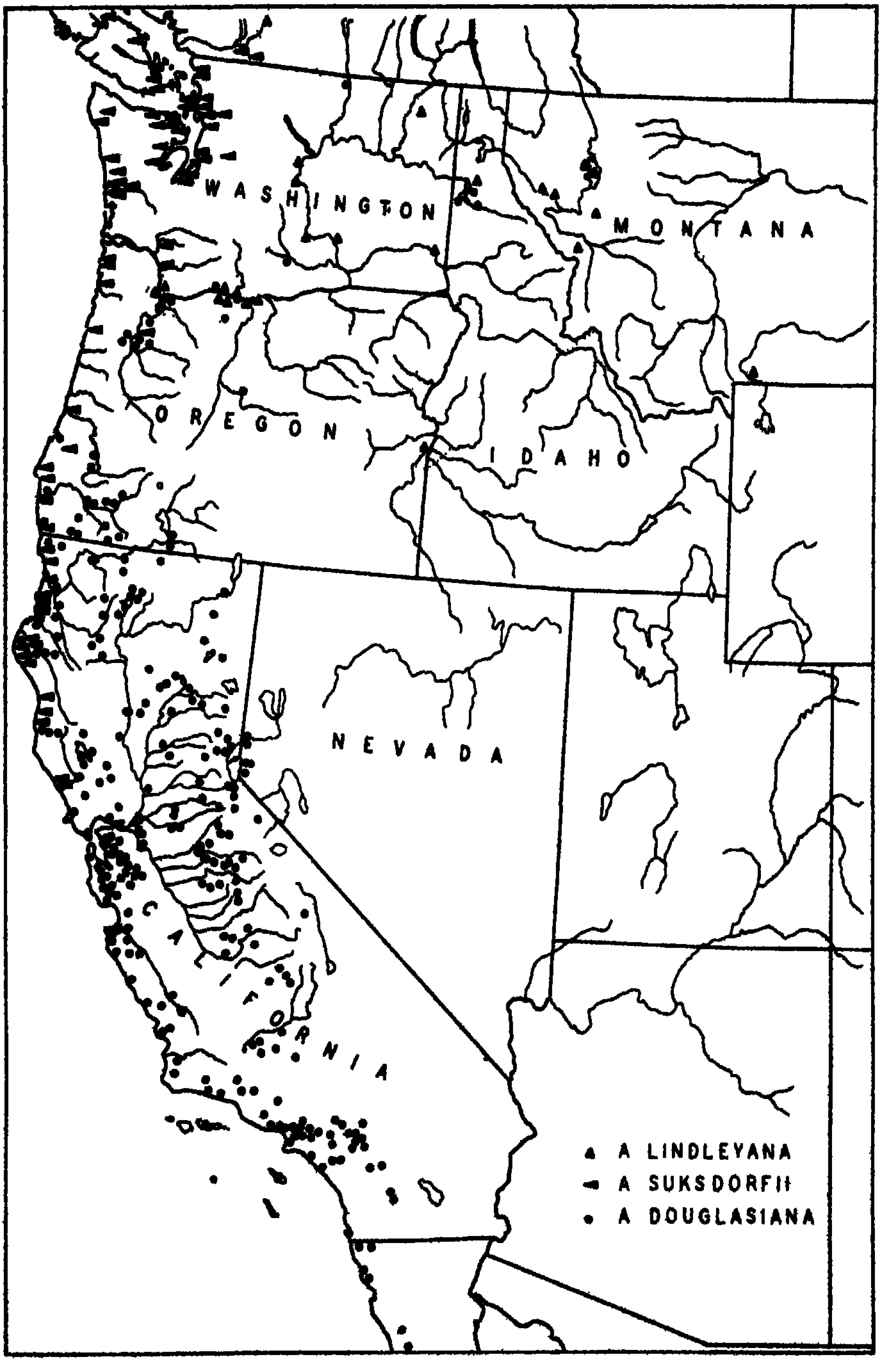


Figure 17. Distribution of *Artemisia Lindleyana*, *A Suksdorfii*, and *A Douglasiana*.

Artemisia Lindleyana α legitima Bess , *ibid* "Folia integerrima 1–1½ longa, vix ⅛ lata " By inference, Douglas no 16

A Lindleyana β brevifolia Bess , *ibid* "Fors status serotinus nam adsunt tantum folia fasciculorum unguicularia " By inference, Douglas no 14

A Lindleyana γ subdentata Bess , *ibid* "Folis versus apicem uno alterne 1–½″ [half inches] longa, 1–2‴ [lines] lata " By inference, Douglas no 18

A Lindleyana δ Coronopus Bess , *ibid* "Folia *Plantaginis Coronopi* " These varieties are leaf variations that appear to have no ecotypical value

A pumila Nutt., Trans. Amer Phil. Soc II 7 399, 1841 not Link, 1822 A starred specimen labeled in Nuttall's hand "Artemisia *pumila R Mts U Calif " seen in Philadelphia Academy

A tenuis var *integerrima* Rydb , Mem N Y Bot. Gard 1 432, 1900 Lower leaves missing but upper ones entire, green, very lightly villous on under surface, herbage glandular; stems glabrate, sulcate. Assigned to this species somewhat doubtfully Type locality Emigrant Gulch, Park Co , Montana.

A arachnoidea Sheld , Bull Torr Club 30 310, 1903 Leaves linear lanceolate, tapering to base and apex, very green, but somewhat tomentose beneath. A wide leaved form of this, rather than of *A Douglasiana* to which it was assigned by Hall and Clements (under the name *A vulgaris* ssp *heterophylla*) Type locality sandy banks of the Columbia River, 1 mile west of Vancouver, Washington

A Leibergii Rydb , N Amer Fl 34 267, 1916 Leaves narrow in type specimen, remotely but sharply toothed apically, nearly glabrous Type locality Fish Hook Ferry, Adams Co , Washington

A vulgaris ssp *Lindleyana* Hall et Clem , Carn Inst Wash Publ 326 79, 1923

A vulgaris var. *Lindleyana* Jeps , Man Fl Pl Calif 1142, 1925

Chamaephyte, stems 2–4 dm tall, several from a woody base; basal leaves linear-oblanceolate (rarely spatulate or wider), entire to serrate-dentate apically or more deeply lobed, often crowded, with fascicles developing in their axils, the upper mostly entire, 2–5 cm long, mostly less than 1 cm wide, tomentulose throughout, or more commonly green and glabrate above, white-tomentose beneath, inflorescence a racemose or spike-like panicle, usually narrow and short, 1–2 cm wide, involucre campanulate, 3 mm high, 2–3 mm. wide, usually lightly tomentulose, with 9–13 bracts, ray-florets 5–9, disk-florets 10–30

Drainage of the Columbia River, mostly along the banks of this stream and its tributaries, from western Montana and southern British Columbia to Washington and Oregon, mostly from low elevations, but ascending to 1980 m in Montana Flowering from July through September.

British Columbia Yale, Sicamous, July 3, 1889, *Macoun* (NY, doubtfully referred here). New Westminster Fort Hope, *Howell 7766*. Montana. Flathead Flathead Lake. Sanders Weeksville, *Leiberg 1567; Plains, Kirkwood 2510* Lake. St Ignatius, Mission Mts., *Kirkwood 1847*. Missoula: Monture Trail Park: Emigrant Gulch, Aug 23, 1897, 6500 ft , *Rydberg and Bessey 5201a* (NY, type of *A. tenuis* var *integerrima*, isotype, US) Idaho. Kootenai near Thompson Mt., *Leiberg 1610* Washington Stevens Old Ft. Colville Whitman Wawawai Franklin Fish Hook Ferry, *Leiberg 935* (NY, type of *A Leibergii*, phototype, C, isotype, US), *934, 936, 937* Chelan Entiat; Wenatchee Yakima Priest Rapids. Klickitat Grand Dalles, *Keck 841*. Clark: Vancouver, Aug. 31, 1902, *Sheldon S 11884* (NY, type of *A arachnoidea*, isotypes, Po, US). Oregon. Malheur. 3 mi N of

Adrian, *Peck 16070*. Sherman: Biggs, *Hall 11638* Wasco mouth of Deschutes River Hood River. Hood River Multnomah Hayden Island.

This species has not been well understood Attention has been focused only on traditional taxonomic characters, and little attention has been paid to its distribution and ecologic connections As a result an unnatural assemblage of plants, distributed very disruptedly over most of the western states and having superficial similarities in leaves and inflorescence, has been assembled under this name For these reasons it was not discovered that *A Lindleyana* is a suffrutescent, narrow-leaved species, that follows the banks of the Columbia River and its tributaries

The nearest connections of *Lindleyana* appear to be with sspp *incompta* and *typica* of tetraploid *ludoviciana*, but possibly a close relationship can be demonstrated between it and hexaploid *Douglasiana*

8 **Artemisia Suksdorfii** Piper, Bull Torr Club 28 42, 1901

Figures 3, 10, and 17

Type locality Stony sea-beaches near Fairhaven, Washington

Artemisia heterophylla NUTT, Trans Amer Phil Soc II, 7 400, 1841, in part, not Bess., 1834

A vulgaris var *litoralis* SUKSD, Deutsch Bot Monatschr 18 98, 1900 This and *A Suksdorfii* are based upon the same type collection

A vulgaris ssp *litoralis* HALL et CLEM, Carn Inst. Wash Publ 326 76, 1923

Stems 6–12(–15) dm tall, stout, herbaceous, or somewhat suffrutescent at base, leaves all broadly lanceolate to elliptic, tapering to base and apex, or some broadly oblanceolate and merely obtuse at apex, entire or with a few coarse teeth or short lobes, gradually reduced within inflorescence, 8–15 cm long, 1 5–3 cm wide, all strongly discolored, bright deep green and glabrous or sparsely tomentulose above, silvery tomentose beneath, usually plane, inflorescence a very dense terete or narrowly ovoid leafy panicle, 4–10 cm broad, heads small, commonly erect, involucre terete or narrowly ovoid, 3–4 mm high, less than 2 mm wide, slightly tomentulose or glabrate, yellow-green and shining, with 6–9 bracts, ray-florets 3–7, disk-florets 2–8 $n = 9$

Vancouver Island southward to Sonoma County, California, in the immediate vicinity of the coast, following a few of the rivers a short distance inland, apparently not ascending more than 100 m above sea-level

BRITISH COLUMBIA Westminster Chilliwack Valley, *Macoun 26352* Nanaimo Qualicum, Alberni Canal, Ucluelet Victoria Sidney, Victoria WASHINGTON Whatcom Chuckanut Bay, *Suksdorf 980* (C, NY, US, *isotypes*) San Juan Kanaka Bay, *Zeller 900* Snohomish Dean Creek, S of White Horse, *Keck 5205*. Clallam· Sequim, Olympic Mts, *Elmer 2603*, Beaver, Mora. Jefferson· Duckabush King Seattle, E of Scenic Mason Hoodsport Pierce Steilacoom. Grays Harbor Montesano, *Heller 3976* Cowlitz. 4 mi N. of Kelso, *Keck 5213*, Woodland. OREGON Clatsop Seaside. Tillamook Garibaldi. Marion: Chemawa Lincoln· Taft, *Keck 5217* Douglas. mouth of Umpqua River, *T Howell* Coos. McKinleyville Curry: Langlois, Gold Beach; mouth of Chetco River CALIFORNIA Del Norte S of Klamath, *Keck 5226*. Humboldt. Scotia, Cape Mendocino, Shelter Cove Mendocino Westport, Fort Bragg Sonoma· Duncan Mills.

Chromosome counts were made in meiotic divisions of plants from White Horse, Snohomish Co , Washington, and Trinidad and Van Duzen River near Carlotta, Humboldt Co , California, and in somatic plates in root-tips of plants from north of Fort Bragg and Jenner, California

A collection from the Columbia plains, *Nuttall* (NY, Ph) is labeled and starred by Nuttall as his *A heterophylla;* but Hall and Clements chose as the type of this entity the sheet in Gray Herbarium which has locality data corresponding to that in the original description, and this sheet is *A. Douglasiana* Bess Nuttall lumped the two collections (and species) without detecting the importance of the differences between them.

Despite an exact duplication of habit, the more strongly discolored leaves, very narrowly cylindric and yellowish glabrate heads, and compact inflorescence of *Suksdorfii* serve to distinguish this species at a glance from *Douglasiana* in the field

9 **Artemisia Douglasiana** Bess in Hook , Fl Bor Amer 1 323, 1833

Figures 6, 10, and 17

Type statement "North-West America *Douglas, in Herb Lindl* "

Artemisia vulgaris var *californica* Bess , Linnaea 15 91, 1841 Type locality San Francisco

A heterophylla Nutt , Trans Amer Phil Soc II, 7 .400, 1841, in part (as to the specimen at Gray Herbarium chosen by Hall and Clements as the type, not as to starred specimen at Philadelphia) , not Bess., 1834

A ludoviciana var *Douglasiana* D. C Eat. in S Wats , Bot. King's Expl 183, 1871

A Kennedyi A Nels., Proc Biol Soc Wash 18 175, 1905 The interior form of the species that has migrated eastward through the low northern Sierran passes Type locality Verdi, Washoe Co , Nevada

A vulgaris ssp *heterophylla* Hall et Clem , Carn Inst Wash Publ 326 76, 1923

A vulgaris var. *heterophylla* Jeps , Man Fl Pl Calif. 1142, 1925

A vulgaris ssp *Douglasiana* St John, Fl S E Wash 422, 1937

Stems 5–15(–30) dm tall, stout but herbaceous to base, simple or sometimes ± branched, the branches erect to divergent, leaves all lanceolate to elliptic and entire, or oblanceolate to obovate in outline and coarsely few-lobed or toothed toward apex, with the margin extremely variable in outline, the entire lobes mostly lanceolate, 7–15 cm long, 1–3(–5) cm wide exclusive of salient lobes, those of the inflorescence gradually reduced in size, all strongly discolored, sparsely tomentulose to glabrous and green above, densely gray-tomentose beneath, usually plane, inflorescence a leafy open or dense elongated panicle, 3–15 cm broad; heads medium-sized, erect or nodding, involucre campanulate, 3–4 mm high, 2–3 mm wide, ± tomentose, with 8–14 bracts, ray-florets 6–10, disk-florets 10–25. $n = 27$,

Washington to northern Baja California, rare east of the Cascadean-Sierran axis except about Lake Tahoe where it extends slightly into Nevada, and at elevations rarely up to 2000 m ; local in northern Idaho Flowering from June to October

"Rocky Mountains by streams," *Nuttall* (Gray, type of *A heterophylla* Nutt as fixed by Hall and Clements, tracing, C) IDAHO Kootenai Lake Coeur d'Alene, 1892, *Aiton* (Po) Benewah St Joe River below St Maries NEVADA Washoe. Verdi, Sept 29, 1904, *Kennedy 963* (RM, type of *A Kennedyi*) Douglas Glenbrook WASHINGTON Okanogan Oroville, June 26, 1911, *Jones* Yakima Yakima region, *Cotton 876* Klickitat *Suksdorf 871* Columbia River, North West America, 1830, *Douglas* (Herb Benth, Kew, possibly of the type collection) OREGON Hood River Lookout Mt, 4000 ft, 1926, *Simon* Multnomah Portland, *Sheldon 11155* Marion Salem Crook Prineville, *Leiberg 837* Klamath Lake Ewana, *Lawrence 1196* Douglas Riddle Coos *Marshfield, House 4991* Jackson Trail Creek, S of Ruch, Siskiyou Mts, *Heller 12635* Curry Brookings. CALIFORNIA Without exact locality, 1835, *Douglas* (Herb Hook, Kew, possibly type collection of *A vulgaris* var *californica*). Modoc Alturas, *Hall 11670* Siskiyou Yreka, *Butler 1798* Lassen Horse Lake Shasta Castella Trinity summit Scott Mts, Yolo Bolly Humboldt Hoopa Valley, Van Duzen River opposite Buck Mt Plumas Red Clover Valley, *Heller and Kennedy 8876* Tehama Payne Creek Butte Jonesville, *Copeland in U C set 484* Glenn Chico Landing Mendocino Comptche, *Jones 29108* Nevada Donner Lake, Grass Valley Yuba Dobbins Colusa Princeton Lake Snow Mt, Kelseyville Eldorado Fallen Leaf Lake, White Hall Solano Vallejo Marin Tiburon, *Heller 5724* San Joaquin Holt, plants over 11 ft high, *Howell 5514* Contra Costa Berkeley Mono Walker River, 11 mi S of Coleville, *Wolf 3279* Tuolumne Confidence, Mather, *Keck 1336* Mariposa Yosemite Valley Madera 7 mi from French Meadows, *Kennedy and Doten 420* Inyo Sobrina Lake, *Jones* Fresno *Laton, 4 m* tall, *Hall* Tulare Hockett Meadows, 9400 ft, *Purpus 2095*, 10 *mi* E of Visalia. Kern Rosedale, Tehachapi Pass Santa Clara Palo Alto, *Baker 1563*, Arroyo Bayo Stanislaus Adobe Creek, Red Mts Monterey Pacific Grove, *Heller 7195* San Luis Obispo Santa Margarita Santa Barbara Santa Maria, Santa Cruz Island, *Rand 71* Ventura Sespe Creek, Triunfo Los Angeles Mesmer, *Abrams 2955*, Claremont, Swartout Valley, Santa Catalina Island San Bernardino Victorville, *Parish 10583*, Mill Creek Canyon Riverside Keen Camp, Cold Water Canyon Orange Newport Beach San Diego Warner Springs BAJA CALIFORNIA. Tia Juana, Rio Santo Domingo, *Wiggins and Demaree 4781*, Rancho San Jose, E of San Telmo, *Wiggins and Demaree 4835*.

Chromosome counts were made on the following plants, all somatic counts on single plants from California stations unless otherwise indicated Santa Barbara (also meiotic), Pismo Hills, 30 m elev, Halls Valley, Mt Hamilton, 490 m (two plants), Santa Cruz Mts between Los Gatos and Glenwood, 450 m, Mather, 1400 m (two plants), Smith Peak, Yosemite National Park, 2200 m (one plant somatic, one meiotic), Medford, Oregon, 415 m

In the San Francisco Bay region, the leaves of *Douglasiana* are usually more lobed than elsewhere, but this deviation from the usual pattern is insufficient to warrant nomenclatorial recognition

The hypothesis has been proposed by Clausen, Keck, and Hiesey (1940a, pp 342–344), that *Douglasiana*, a hexaploid species of inland valleys and moderate altitudes on the Pacific slope, originated by amphidiploidy (addition of the chromosomes) from the coastal diploid species, *Suksdorfii*, and the interior montane tetraploid, *ludoviciana*, whose essential characters it recombines Transplant experiments demonstrated that the tall *Suksdorfii* is unfitted to occupy higher elevations. It was even a poor survivor at the Mather transplant station at 1400 m elevation where *Douglasiana* is native. The smaller statured *ludoviciana*, on the other hand, ranging widely toward the eastward, has been able to occupy even alpine habitats. It enters the range of *Suksdorfii* in the Columbia River Gap, and here hybridization may have been possible *Artemisia Douglasiana* is found in the geographically and climatically intermediate zone between the ranges of its presumed parents

10 **Artemisia Prescottiana** Bess. in Hook., Fl Bor Amer 1·324, 1833

Figure 10

Type statement. "North-West America *Douglas in Herb. Lindl*" Known only from the type collection made in 1825 by David Douglas on the Quick Sand River, near the Grand Rapids of the Columbia (This is near The Dalles, but whether from the Washington or Oregon side is undetermined) The sheet in Bentham's herbarium at Kew has been studied A note on it by R. A. Rolfe states that it exactly corresponds with the type of *A Prescottiana* in the Lindley Herbarium A drawing and fragment of this plant are at New York

Stems 3–4 dm tall, slender, several branching from the slender slightly suffrutescent base, striate, smooth and shining, like especially the under surface of the leaves very sparingly arachnoid-pilose, the very slender hairs mostly spreading, leaves 2–5 cm. long, less than 1 mm wide, pinnatifid with 3–7 filiform caudate entire divaricate remote divisions 5–18 mm long, or those of the inflorescence entire, green, the margin closely revolute, inflorescence racemose, sparingly leafy, the few erect heads on short filiform pedicels well spaced; involucre hemispheric, 3 5–4 mm high, 4–5 mm wide, green and shining, the 10 bracts very sparingly arachnoid-pilose, ± ciliate, ray-florets 6, disk-florets 23 (only one head counted)

I have seen no other specimen than the one in the Bentham herbarium that could be referred to this species, so it is assumed that it is a local endemic not as yet rediscovered, or that it is by this time extinct The branching base is unique, slender branches developing from each of the lower nodes, the lowest and strongest become flowering stems, those a little higher are sterile almost capillary leafy shoots about 10 cm long The filiform and filiform-lobed leaves, which are not at all fascicled, and the pubescence are also unduplicated, and the racemose arrangement of the heads is only approached in forms of *A. Lindleyana* and *A Michauxiana*, plants that otherwise have very little in common with this In other words, while the floral characters plainly show that *A Prescottiana* is a member of this complex, it does not seem to be very closely related to any other species

11 **Artemisia Tilesii** Ledeb, Mem Acad St Petersb 5 568, 1814

11a. **Artemisia Tilesii** Ledeb ssp **typica** Keck nom nov

Figures 10 and 18

Type locality Kamchatka Type not seen

Artemisia Tilesii LEDEB., *loc cit*

A. Tilesii var *arctica* BESS. in Hook, Fl Bor Amer 1·324, 1833 "Ex littoribus arcticis est var. ζ arctica—foliorum laciniis integerrimis magis distantibus obtusis brevibus, periclinii flosculisque pallidis"

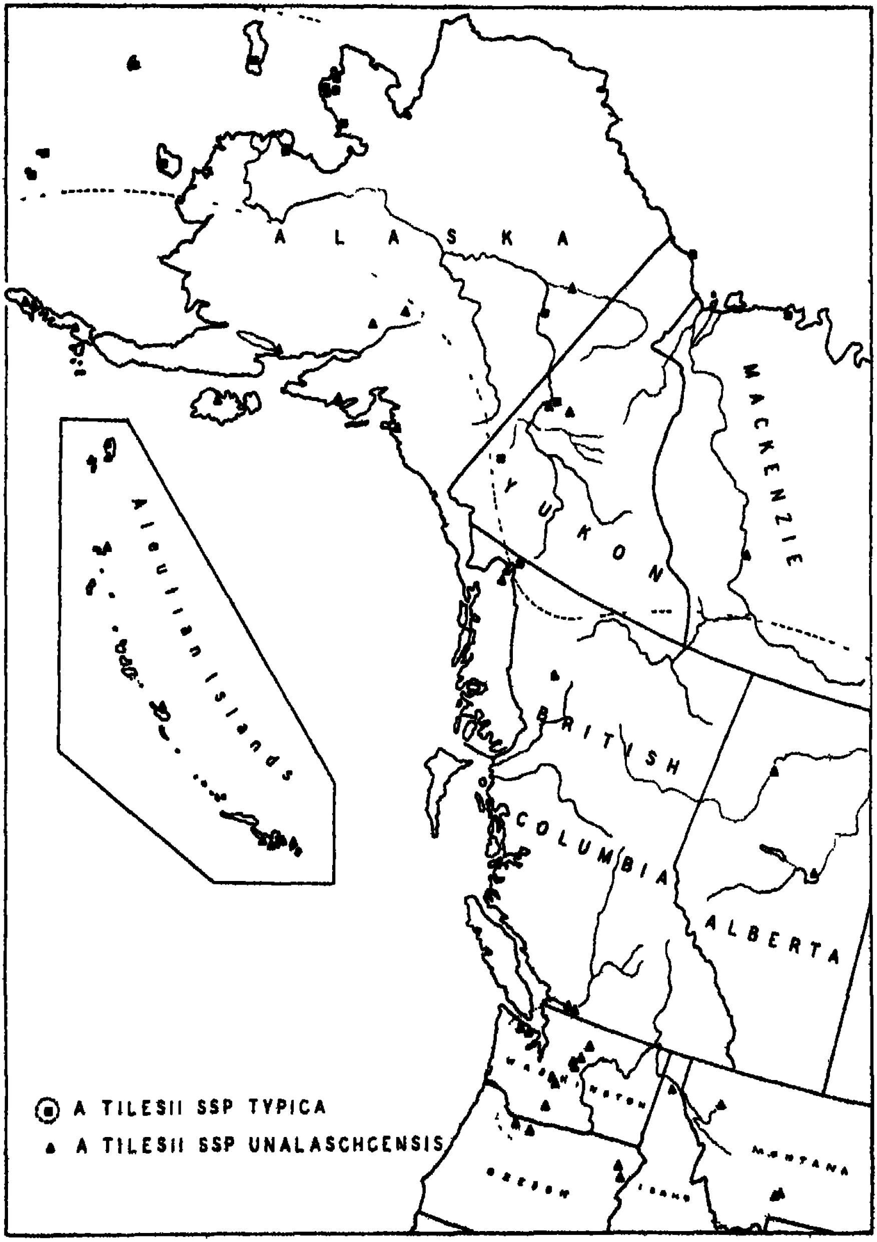


Figure 18 Distribution of *Artemisia Tilesii* in North America.

A vulgaris var *kamtschatica* Bess , Nouv Mém Soc Nat Mosc. 3 ·54, 1834.

A vulgaris var *Tilesii* Ledeb., Fl Rossica 2 586, 1844–46.

A. vulgaris ssp. *Tilesii* Hall et Clem., Carn Inst. Wash Publ 326 72, 1923.

Stems 1 5–6 dm tall, floccose when young but soon glabrate, leaves ovate to lanceolate in outline, deeply incised into 3–5 lanceolate attenuate sparingly toothed or dentately lobed divisions, the leaves of the inflorescence merely toothed or entire, all strongly discolored, green above, tomentose beneath, inflorescence a rather compact spike-like panicle often overtopped by the leaves, heads nodding, large, involucre hemispheric, 4–5 mm high, 6–9 mm wide, the bracts 12–28, ± anthocyanous, with broad scarious margin, glabrous and shining, or the outermost somewhat tomentose along midrib, ray-florets 9–25; disk-florets 20–100

Nova Zembla, northern Siberia and Kamchatka to the Pribilof Islands, central and northern Alaska, Yukon Territory and east to Hudson Bay Flowering from June to September

North American stations. Alaska. Bering Sea, *Macoun 89*, St Lawrence Island, St Matthew Island, Nunivak Island, Punuk Island, St Paul Island, St George Island, Kutzeblok, Taylor, Nome, *G. N. Jones 9211*, Norton Sound, Postoliak River, Yukon Delta, Circle Yukon Herschel Island, Arctic Ocean, Aug 19, 1896, *A Seale* (SU), Dawson, *Macoun 79012*, Lake Kluane to Don Jek River, 1920, *Muller* British Columbia White Pass, *Eastwood 899* Mackenzie Arctic shore between Mackenzie and Coppermine rivers, *Richardson* (NY), Coppermine River, Tree River, Hood River, Bathurst Inlet Manitoba. Churchill, Hudson Bay, lat. 58° 50′, *Macoun 79263*

11b **Artemisia Tilesii** ssp **unalaschcensis** (Bess.) Hultén, Fl Aleut Ids 327, 1937

Figures 9, 10, and 17

Type locality Island of Unalaska Type not seen

Artemisia Hookeriana Bess in Hook., Fl. Bor Amer 1 322, 1833 The type, from Rocky Mountains, Canada, *Drummond* (Kew), has been studied. A sheet that matches the fragmentary type specimen so closely as to seem to be part of the same plant is labeled, R Mts, Saskatchewan, 4–5 ft, *Drummond 23* (Kew) Leaves strongly discolored, bright green above, very white beneath, to 17 cm long, many entire, linear lanceolate, tapering to base and apex, some with 1–5 remote salient linear oblong usually entire lobes 1.5–4 5 cm. long

A vulgaris var *vulgatissima* Bess. in Hook., *ibid.* Not seen but probably referable here. Type statement "North West coast. *Douglas, in Herb Lindl*"

A vulgaris var *americana* Bess , Linnaea 15 105, 1841, in part, judging from the distribution and description Not seen

A Tilesii var. *unalaschcensis* Bess , *ibid* 106

A Tilesii var *elatior* Torr. et Gray, Fl N. Amer 2 422, 1843 "Subarctic America, *Richardson*"

A elatior Rydb , Mem N. Y Bot. Gard 1 430, 1900

A unalaskensis Rydb , N. Amer. Fl 34 266, 1916. Not based on *A Tilesii* var *unalaschcensis* Bess 1841 Type collected on the island of Unalaska, Aug. 22, 1891, *Macoun 20625.* Leaves large, subpalmately parted or divided, the lobes again cleft.

A Gormanii Rydb , *ibid.* 267 "Type collected in the Lake Iliamna Region, Alaska, September 1, 1902, *Gorman 281* (U S. Nat Herb *no. 480345*)" Leaves more finely cut and the divisions more slender and attenuate and the inflorescence less leafy than the type of *A unalaskensis* Rydb. This is the form first described as *A. Tilesii* var *elatior* Torr et Gray

A obtusa RYDB, *ibid.* 274 This plant, known only from the type specimen, collected "on the Columbia" by Scouler, no 234, is very doubtfully placed here Scouler's collections were confined to the year 1825 and apparently were taken near the ocean along the coast from Nootka Sound, Vancouver Island, southward to the mouth of the Columbia, and at Fort Vancouver The fact that this form has apparently not been recollected leaves its status in much doubt The plant has leaves thicker in texture and more floccose on the upper surface, but otherwise cut about the same as those found in *A Tilesii* ssp *unalaschcensis*

A Tilesii var *elatior f pubescens* G N JONES, Univ. Wash Publ Biol. 5·254, 1936 A form from the Olympic Mountains in which the involucre is tomentose.

A unalaskensis var *aleutica* HULTÉN, Fl. Aleut Ids 327, 1937 Form with even the upper side of the leaves subtomentose lanuginous Type not given, but first plant cited was collected on Atka Island in 1834 by *Wrangell* (Leningrad) The variety is said to be limited to the middle and western Aleutians.

A ludoviciana var *americana* FERN, Rhodora 47 248, 1945. Both Fernald and the writer have tried to place Besser's variety on the basis of the original description alone, and the results do not agree Fernald includes in it an assemblage of forms having leaves bright green above and panicles leafy and open, scattered from the Lower Athabasca River, northern Alberta, to northern Mexico The writer assigns duplicates of the collections Fernald cites to five different units the type, at least, to the present subspecies, most of the remainder to four subspecies of *A ludoviciana*, namely, sspp *mexicana* (Texas, New Mexico, Colorado, in part), *incompta* (Idaho), *typica* (Colorado, in part), and *sulcata* (Arizona) Fernald himself cites two of them again under his *A ludoviciana* var *mexicana*

Stems 3–15 dm tall, floccose when young but soon glabrate, leaves extremely variable, linear-lanceolate to oblanceolate, ovate, or subrotund in outline, the narrowest sometimes quite entire, the others bluntly or sharply few-toothed or -lobed to deeply pinnately, or commonly subpalmately, divided with some of the segments again toothed, lobed, or parted, those leaves with merely teeth or lobes often with wide lamina, those again lobed often with narrow lamina and segments, floral leaves entire or nearly so, all strongly discolored, green above (rarely tomentulose), tomentose beneath, plane, or the margin somewhat revolute, inflorescence a ± elongated narrow spike-like panicle, sometimes rather open, or a broad dense spike, well exceeding the leaves, heads erect or nodding, large, involucre hemispheric to broadly campanulate or turbinate, 3–5 mm high, 4–8 mm wide, the bracts 11–13, often darkly anthocyanous, sometimes green, with broad hyaline margin, glabrate or tomentulose, ray-florets 8–15, disk-florets 20–40. $n = 27$

Northern Japan (Hokkaido, etc) to Kamchatka, the Aleutian Islands, southern Alaska, Yukon and Mackenzie, southward to western Montana and northern Oregon, from sea-level in the north up to 1830 m elevation in the south Flowering from July to September

North American stations: Attu Island (as *A unalaskensis* Rydb.) and Attu, Agattu, Kiska, and Atka islands (as *A unalaskensis* var *aleutica* Hult) all reported by Hultén, *loc. cit* Unalaska Id · Aug. 22, 1891, *Macoun 20625* (Canada, type of *A unalaskensis*, phototypes, C, CAS, NY, US), *Eyerdam 2346*, Dutch Harbor Akutan Id., *Norberg 382* Unimak Id . False Pass, *Eyerdam 2350* Kodiak Id Old Harbor ALASKA. Porcupine River, *Turner*, Wonder Lake, McKinley National Park, *Mexia 2352*; Lake Iliamna region, sandy and rocky slopes above high tide south of Iliamna Point, Sept. 1, 1902, *M. W Gorman 281* (US, type of *A Gormanii*, phototypes, C, NY), Yentna District, above Morgan Creek; Seward; Cordova, *Mexia 2311*, Red River, Skagway, Chilkat Valley, *Walker 1077*. YUKON. Dawson, *Eastwood 455*, Klondyke MACKENZIE Fort Wrigley, *Preble and Cary 86* ALBERTA. Peace River 10 mi above Carcajou Settlement, *Raup and Abbe 4359*, Boiler Rapid, Athabasca River, *Preble and Cary 131* BRITISH COLUMBIA. Cassiar District, pass near head Tset-ee-yeh River, a branch of Klappan River, *Preble and Mixter 640* New Westminster. Chilliwack Valley, *Macoun 26350* MONTANA Flathead McDonald Peak, Flathead Lake, *Jones 8775*. Gallatin Bozeman, mountain canyons, 6,000 ft., *Blankinship 305*. IDAHO Bonner Lake Pend d'Oreille, *Sandberg et al 754a* WASHINGTON Clallam Sequim, Mt Angeles, *Thompson 7502* Chelan Stehekin, Mt. Stuart, Tumwater Canyon, *Thompson 8425* Pierce Mt Ranier, White River. Yakima (?) Mt Adams, *Gardner* "Columbia" (River), *Scouler 234* (NY, type of *A obtusa*, phototype and fragments, C) OREGON Wallowa Wallowa Mts, *Piper 2491* Baker Cornucopia, *Jones 29110* Hood River N side Mt Hood, *Thompson 3530* Multnomah Columbia River above Multnomah Falls, *Hall 11997*

The chromosome number was determined at meiosis in a plant originating from seed of Hultén's plants from Unalaska grown at Stanford

Both ssp *typica* and ssp *unalaschcensis* are highly variable, but they appear to represent fairly clear regional subdivisions of the species *Tilesii* Some specimens, however, must be classified rather arbitrarily The wide range of variation has prompted other workers to name many forms as the extended synonymy indicates But this variation is extensive even in plants grown from single localities such as Unalaska Island, and there is no indication that there are any barriers to free interbreeding and recombination

DISCUSSION AND CONCLUSIONS

In North America eleven species are recognized in the subsection *Vulgares* of *Artemisia*. All but one of these are polymorphic, several being highly so. Two contain recognizable geographic subspecies (there being seven such in *A. ludoviciana*). The conventional taxonomic treatment shows that additional cytogenetic investigations of this group are needed. In fact, the abundance of members of this complex in the North American flora, their great diversity of form, and their differences in chromosome number challenge our imagination and invite experimental studies.

An obvious opportunity for further work lies in a cytological survey of the subsection. Enough chromosome counts have been made to show that this is a typical example of the polyploid complex. There are special opportunities for evolution in such complexes, for a great diversity of habitats is occupied by forms closely enough related to allow some mixing of hereditary strains. This in turn produces variation and allows some of it to become fixed through genetical and ecological selection. It is to be expected that in such a complex both mutations of various sorts and hybridization have played major roles in building up the variation.

One of the ways in which sudden new steps in the evolutionary history may arise, and the variation increase, is through the crossing of two rather distantly related species. The probable origin of *A. Douglasiana* through the addition of all the chromosomes of two other species is an example. The strong circumstantial evidence for such an origin is given elsewhere (cf. p. 459), but here it should be pointed out that one of the supposed parents, *A. ludoviciana,* is exceedingly variable and occupies a wide range of habitats, while the other, *A. Suksdorfii,* is both morphologically stable and very limited in its choice of habitats. The evolutionary opportunities of *Suksdorfii* at the present time appear therefore limited, although this should not lead us to the conclusion that it is either a rare or decadent species. Also, if the theory of the origin of *Douglasiana* is correct, the chromosome set of *Suksdorfii* combined with that of *ludoviciana* to form the aggressive and variable species, *Douglasiana*. The evolution of a new species by the addition of the chromosomes of two others tends to revitalize the entire complex to which they belong. The potential significance of *Suksdorfii* in the evolutionary course of the complex is therefore enhanced through the chromosomes it probably contributed to *Douglasiana*.

The accompanying diagram, figure 19, attempts to show the North American members of subsection *Vulgares* placed very roughly in the relative positions they would assume on a map of the continent. The geographical ranges are much generalized, and accurate limits are to be found under the taxonomic treatment. Chromosome numbers are given where known. The arrows suggest possible courses of evolution as gathered from the available evidence on morphological and cytological relationships. The intangible impressions that come from an intimate study of a group have also played a part here.

In the case of *A. Douglasiana* mentioned above, arrows indicate its probable origin from *A. Suksdorfii* and *A. ludoviciana*. The subspecies of *ludoviciana* that seems to be the most likely forebear of *Douglasiana* is uncertain, but both sspp. *candicans* and *typica* are suggested. Aside from this case, in which the circumstantial evidence is strong, our present information is too fragmentary to indicate origins; therefore, for most of the systematic units more than one alternative must be considered.

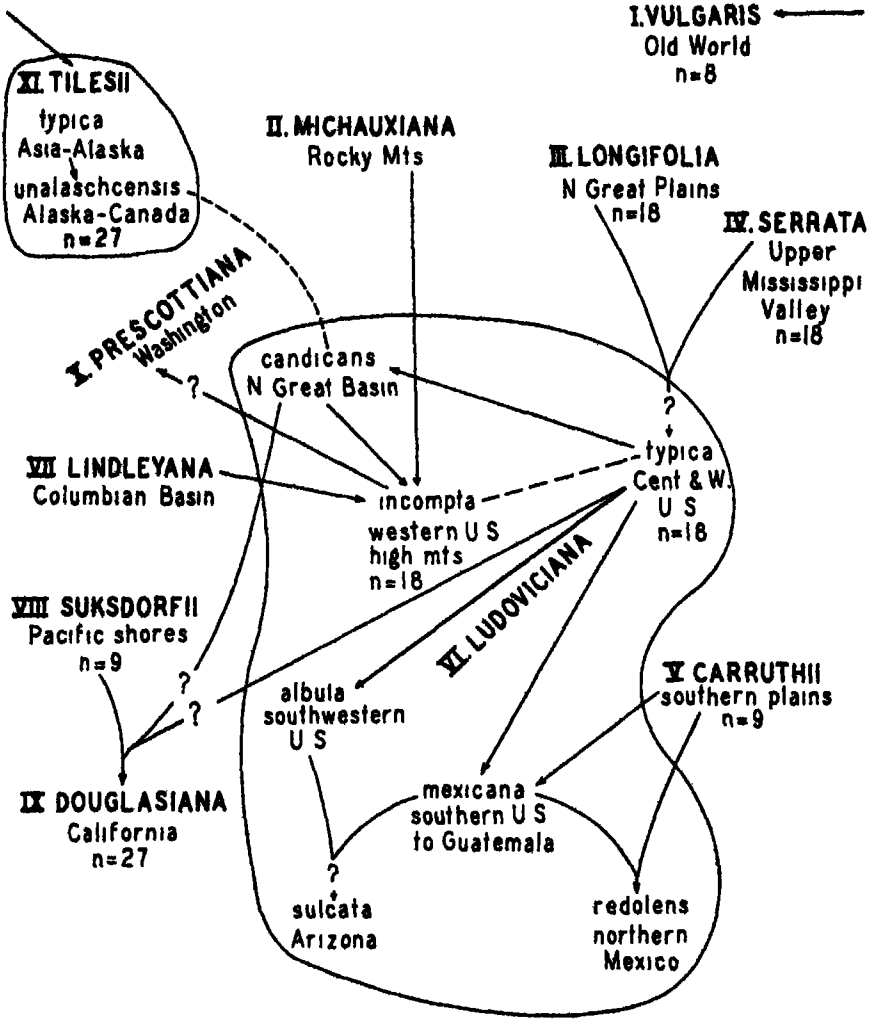


Figure 19. Chart of possible relationships, showing the relative geographical position and some chromosome numbers of the subsection *Vulgares* of *Artemisia*. See text.

In the other instances in the chart in which arrows from two forms point to a third one, amphidiploidy or even hybrid origin is not to be inferred, although that possibility need not be ruled out. Such arrows merely indicate that on the present evidence it is difficult to determine the exact relationships and possible origins. Furthermore, it is to be readily granted that such variable units as *A. ludoviciana* sspp. *typica* and *mexicana* may have had polyphyletic origins.

The European source of *A. vulgaris* is indicated by an arrow, as is also the probable Asiatic origin of *A. Tilesii*. A broken line calls attention to the morphological-ecological similarity between *A. Tilesii* ssp. *unalaschcensis* and *A. ludoviciana* ssp. *candicans*, Possibly here is an evolutionary connection between *Tilesii* and the other American species.

Scarcely any two units in the North American assemblage are less alike than the only two known diploid species, *A. Suksdorfii* and *A. Carruthii*. Both of these occur on the periphery of the distribution of this complex and occupy extreme climates, the former, an equitable moist coastal zone, and the latter, dry semideserts. Accordingly, they show extreme differences in size, habit, and leaf characters, although they resemble each other in their few-flowered heads. These two species inhabit climates that must have been available from mid-Tertiary time, at least. It is of prime interest to find such ecologic specialization in species that have remained on the diploid level and likely are of great age. *Artemisia Suksdorfii* bears some morphological resemblance to *A. serrata*. The recurrence of this morphological type in the central states suggests that species or ecotypes of that type in the past may have occupied those parts of the North American continent where now the polyploid species are the only representatives.

The diversity of the North American diploids and the presence of another anomalous form like *A. Prescottiana* suggest that great gaps now exist in the evolutionary fabric of this group, making the present-day picture incomplete. Certainly the monophyletic origin of the subsection from any living American species appears quite impossible.

The North American diploids and the Eurasiatic diploid, *A. vulgaris* L., bear no close resemblance to one another. Other diploid progenitors of these must therefore have existed which now are lost.

The greatest diversity in the subsection *Vulgares* appears to be found in North America, and the known facts indicate that the American species (excepting *Tilesii*) originated in America. But, since the complex is distributed both on this continent and in Eurasia, the progenitors of the present-day diploids may have originated on either land mass and migrated across the Bering Straits. *Artemisia Tilesii*, which now is distributed across this migration bridge, appears to have closer ties in Asia than in America, and therefore may be considered as having originated in the west and moved eastward, but the Asiatic flora is not well known as yet, and *Tilesii* may prove to be of American origin. At all events, this highly polyploid species of aggressive distribution is not presumed to be the direct ancestor of any of the other American forms. but rather itself a derivative of the evolutionary stream.

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ALICE EASTWOOD SEMI-CENTENNIAL PUBLICATIONS

No. 18

THE GENUS RUPPIA L.

BY

WILLIAM A SETCHELL
Late Professor of Botany Emeritus, University of California

DURING AN ATTEMPT to find suitable plants to demonstrate the influence of temperature on their growth, differentiation, and persistence, attention was attracted to those of aquatic habitats, since of the two most essential climatic variables, temperature and moisture, moisture is constant The marine algae and the marine spermatophytes have lent themselves particularly well to experimentation and some attention has been paid to each group Of spermatophytes which pass their entire life history submerged, *Zostera* and *Ruppia* are two of those best suited for study *Zostera* was found to be well adapted for observation in the open (see Setchell, Univ Calif Pub Bot, 14 389–452, text fig 59, 1929), and *Ruppia* for observation both in the open and in culture (see Setchell, Proc Nation Acad Sci, 10 286–288, 1924) *Ruppia* is a rather delicate aquatic, without woody tissue of any appreciable amount, with little vegetative storage of starch or proteins, appearing and disappearing according to variation in conditions of habitat, seemingly likely to be fundamentally and quickly affected by changes of temperature and salinity, easy of culture, and offering opportunity of being used as a laboratory plant for the study of the influences of environmental factors

It grows as a rule in shallow brackish water The habitats vary from maritime, and therefore coastal, to interior saline springs, pools, and lakes In many ways it resembles in general habit its near relative, *Zannichellia palus-*

tris L. It is called here by the common name of "Ditch Grass," in England as "Tassel Grass," but few except botanists are aware of its existence.

Linnaeus described the genus *Ruppia* in the *Genera Plantarum* of 1737, referring to Micheli's plate 35 of *Buccaferrea maritima foliis minus acutis* (1729, *Nova plantarum genera*), which he quotes, indicating by a cross (×) placed after the generic name, that he had seen, at that time, only a dried specimen. Since there are discrepancies of detail between the only specimen in his herbarium, labeled "*l maritima*" in his own handwriting (!) (see Plate 47), and the plate of Micheli, we may suspect that the herbarium specimen was acquired later We may conclude that the plate of Micheli clearly represents his conception of both genus and the type species This specimen has a short, nonspiral peduncle Linnaeus had in his herbarium another specimen which he labeled "*Ruppia spiralis*," which has an elongated, spiral peduncle, probably added to his collection later than the *R maritima*

Linnaeus, in 1737, published the *Hortus Cliffortianus*. He mentions *Ruppia* and under it has 2 series, first, among other citations he lists Micheli's *Buccaferrea maritima, foliis acutissimis;* and in the second he lists *Buccaferrea maritima, foliis minus acutis*, pl 35, p. 72. He also indicates that he had collected a specimen near Leyden and had therefore become acquainted with the living plant Linnaeus had not, at the time of the publication of the *Hortus Cliffortianus*, published his idea of varieties under species, but because of his arrangement it may be thought that he considered the two "species" of Micheli to be only varieties of one Linnaeus does not name the second one

In the first edition of the Species Plantarum, Linnaeus simply refers to "*Buccaferrea maritima, foliis acutissimis* Micheli, Gen , 72, t 35, and seemingly unites the two "species" of Micheli The idea of possibly two species of *Ruppia*, distinguished to some extent at least by the differing tips of the leaves, occurs several times in the later literature and perhaps most strongly in Hagström (Botan Notis., 1911, 137) where his idea of *Ruppia maritima* and *R spiralis* is expressed thus . "This has obtuse leaves and that acute " In other words, the *Ruppia maritima* of Linnaeus (*in sensu strict*) has acute leaves, corresponding to the "*foliis acutissimis*" of Micheli, while *R spiralis* has obtuse leaves, thus corresponding to the "*foliis minus acutis*" of Micheli Micheli's figures on plate 35, which are really the type of the genus *Ruppia*, and therefore presumably the *Ruppia maritima* of Linnaeus, show short, noncoiled peduncles, so that the citation of "*foliis acutissimis*" by Linnaeus in the "*Species*" is misleading Linnaeus, however, through the several editions of his "*Genera*," both in description and also by the specimen in his herbarium, suspected as having been collected on the "Westgota Resa," labeled (by him !) as *Ruppia maritima* (Pl 47, gives evidence that the short, nonspiral form was the type both of his genus and of his species The occurrence of a long-spiral, pedunculate form in his herbarium, labeled (by him !) "*Ruppia spiralis*" (Pl 48), still further emphasizes this idea The two specimens in Herb Linn are reproduced in this paper. Linnaeus then, in his herbarium, really recognized two species, *Ruppia maritima* L (Spec. Pl., ed 1, 127, 1753) and *Ruppia spiralis* L. (in herb), which was later published by Dumortier.

About 25 species have been proposed in *Ruppia* by taxonomists and almost all of them have been reduced to varieties or forms of *R maritima*. The chief troubles have concerned themselves in the first place with the lack of realization among both earlier and later writers of the fact that *Ruppia* is dichogamous (see Ascherson, Bot. Zeit., 1871, p. 28, and *in* Engler u. Prantl, Natl. Pfl. Fam , II, 1 199, 1889), with proterandry, in the second place, with the confusion of the types of peduncles, and nature of pollination, in the third place, the ecophenic variable as to length of both peduncle and podogyne, even in the same plant, in the fourth place, varying persistence and robustness of the vegetative parts, in the fifth place, the variability in size and relative obliquity in the maturing fruits, the varying behavior of stigma and rostrum, and finally in the relation of robust and slim fruits so commonly found in the same inflorescence The tendencies to recognize only one species, two species, or several species of the genus have been influenced by these considerations

After Linnaeus, botanists seemingly regarded both series of forms as states or stages of one another. Botanists, such as C A Agardh (1823), W D J Koch (1823, 1824), and others, began to split the Linnaean species, regarding, however, the *spiralis* form as the type Dumortier (in 1827), to avoid confusion, published the name *Ruppia spiralis* From then on some authors have applied this name to the spiral, peduncled form, but the majority have insisted, in spite of the evidence of the record, that this is the type of *R maritima* L , and that the short, peduncled var *rostrata* C Ag (*R rostellata* Koch) is a variety of it Fernald and Wiegand (Rhodora, 16, 1914, p 121) adopt this interpretation of *R maritima*. Hagstrom (*loc. cit* , 1911, pp 137, 138) recognizes the true *R. maritima* as distinct from the true *R. spiralis*.

Ascherson and Graebner (Synopsis, 1907, pp 142–145) recognize one species, *Ruppia maritima* L , consisting of two subspecies, *A spiralis* L Herb , Dumort and *B rostellata* Koch

As a result of our studies, it seems best to recognize two species, *Ruppia maritima* L (1753) with short, nonspiral peduncles (the *R maritima* var *rostrata* of my earlier, 1924, preliminary account), and *R spiralis* Dumort (1827) with elongated, spiral peduncles (the *R longipes* Fernald and Wiegand, *non* Hagström)

These conclusions were arrived at by an extensive study undertaken by myself, with the assistance of several graduate students, of the representatives of the genus as they occur in nature in the marshes around San Francisco Bay, and by culturing plants from these and many other localities

Our cultures were established in beakers of 3 liter capacity. Into each beaker was placed about 100 grams of garden soil and 2 5 liters of water from the taps of the Berkeley water supply. In such cultures cuttings of rhizomes or seeds were planted The beaker was covered with ordinary glass to prevent evaporation, and the plants grew and flourished, some of them for several years without change of water or soil Fresh tap water had to be added from time to time, in small quantities, to make up for the slight evaporation A few cultures were made with natural spring water, with distilled water, and with potassium nitrate or magnesium sulphate added In the two latter cases the plants grew without soil Under favorable conditions, cultures from seed produced seeds in 60–80 days

Ruppia plants, of both types of peduncle, were studied for about 15 years, both from certain localities more or less readily accessible and in cultures The gross morphology of both types of *Ruppia* was studied in all stages from germination to fruit production, particular attention being paid to such uncertain matters as possession or absence of a primary root, types of peduncles, variations in fruit shape, and varying lengths of peduncles and podogynes The definite discontinuity of the two types of peduncle is maintained The ever-varying characters of fruits, podogynes, and peduncles may be expressed very differently on the same individual

From the foregoing studies it is concluded that out of the many described species, there are two valid species in the genus, and that the various species, subspecies, varieties, proles, and forms which have been described are only reversible ecophenic, probably quantitative expressions of form and size Persistence in the habitat is due to a continuation of conditions favorable to development *Ruppia* plants are delicate in response to habitat and store little starch or other nutrient materials In culture they live on indefinitely, but in their native habitats they may be short seasonal plants or longer or shorter lived perennials

My sincerest thanks are due the Linnaean Society of London for permission to study and photograph the specimens of *Ruppia* in the Herbarium of Linnaeus

PLATES

PLATE 47

Specimen of *Ruppia maritima* L Herb Linn, Genus 175 Sheet 1

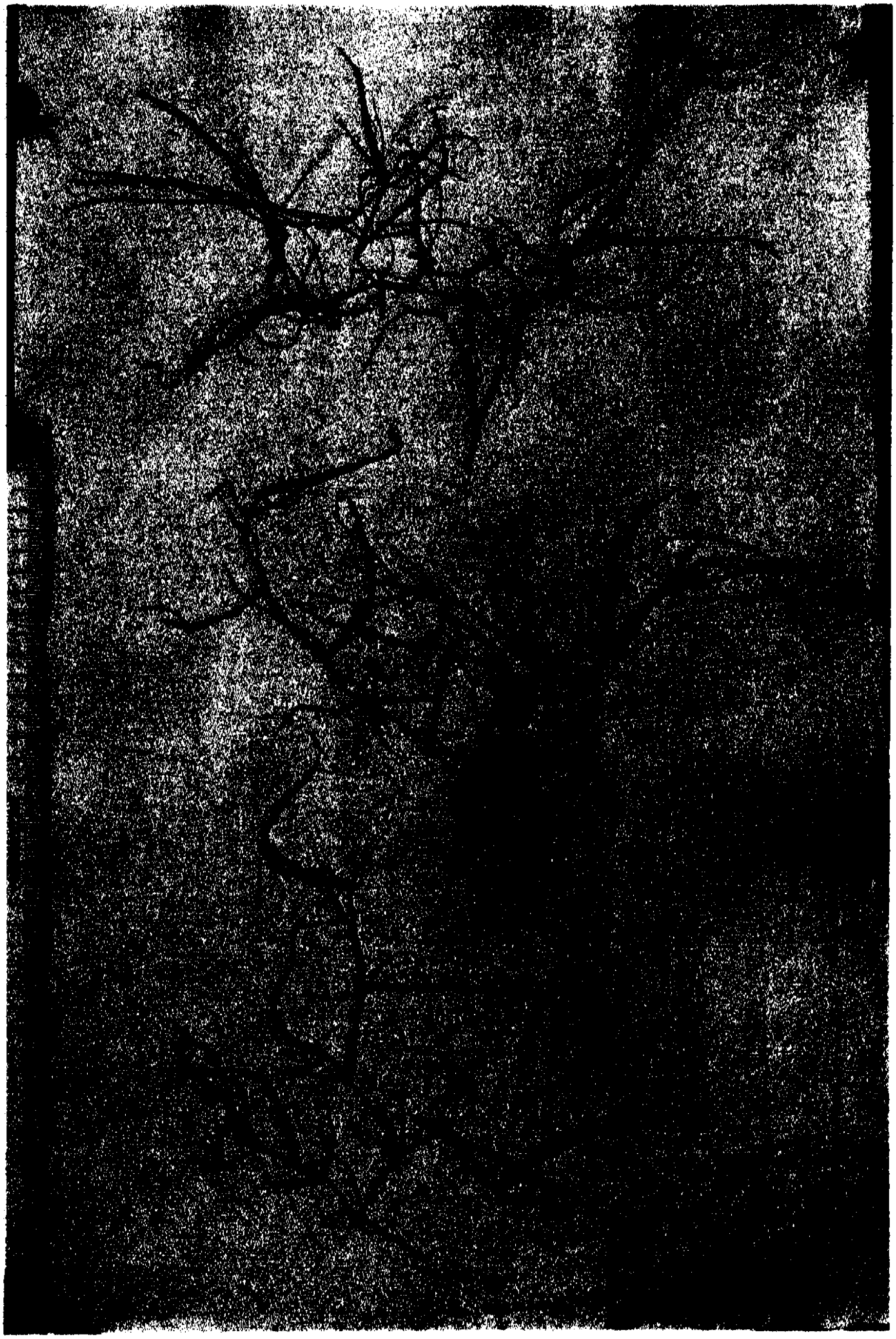
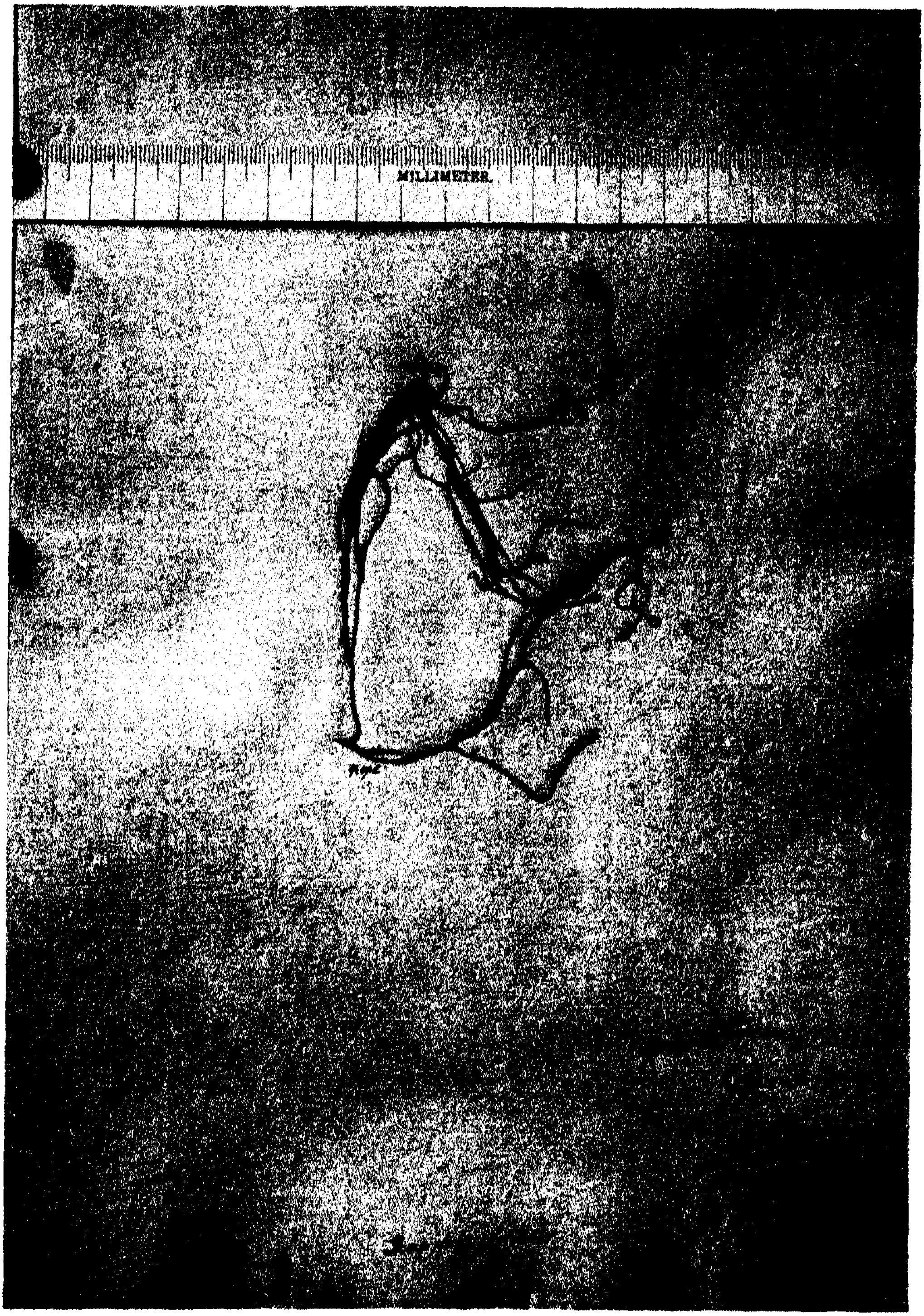


PLATE 48

Specimen of *Ruppia maritima* L Herb Linn , Genus 175 Sheet 2


MILLIMETER.

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